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PART. I

LMFBR SHIELDING BENCHMARK

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Abstract

The present document summarizes the results and discussions relating to the LMFBR shielding benchmark exercise proposed by NEACRP in the report which is given in Annex I and which indicates the specifications of the LMFBR shielding benchmark. The PWR shielding benchmark also discussed at the meeting, will be the subject of a separate document.

Six different organisations participated in the LMFBR benchmark exercise, and eight solutions were submitted. The list of participants and contributors is given in Annex II.

General Comments

At the NEACRP Specialists' Meeting on "Neutron Data and Benchmarks for Reactor Shielding", held in Paris in October 1980, a formal programme of work was agreed upon for the execution of shielding benchmark studies.

It was considered that the status of multigroup cross section sets used by different laboratories had changed significantly in recent years and that it would be of interest for an international intercomparison to take advantage of the recent improvements in calculational techniques and the developments of sensitivity and uncertainty methods.

Actually, the major achievements of the previous meetings of this series had been in stimulating the development of data sensitivity analysis tools and stressing the need for appropriate data uncertainty information, both for meaningful design parameter uncertainty analysis and for effective use of benchmark single-material propagation experiments.

For the present meeting, it was agreed to limit the scope to an intercomparison of the benchmark exercises. In the case of the LMFBR benchmark, the following quantities of interest were requested in the simplified 1D geometry:

- total, thermal equivalent and fast flux responses.
- steel damage dose
- activation rates of Na and Au
- fission rate of U-235
- neutron and γ-heating

All these values were requested at several positions, in the proposed geometrical model, representative in particular of the end of the lateral shield and of the wall of the secondary heat exchanger. The results obtained by the participants are given in Part I of the present document.

Part II of the document gives the details of the analysis of the results, in particular using the sensitivity coefficients provided by the participants.

The main results and conclusions of the exercise can be summarised as follows:

- The spread of the calculated results are much reduced with respect to the results obtained in a similar exercise, and compared at the Specialists' Meeting in Vienna in 1976.
- The observed discrepancies are often related to calculations performed by different laboratories using the same data base with different strategies to produce multigroup data (elastic and inelastic matrix production, composition dependent resonance self-shielding, etc.). This means that, in this area, the methods play a relevant rôle, which is still to be clarified. Continuous Monte Carlo calculations can certainly give useful information. However,

since in particular resonance self-shielding algorithms are, in general, well established, the problem of data processing could be handled more satisfactorily in the future with a more appropriate use of existing algorithms.

- The sensitivity coefficients provided by the participants were in excellent agreement, even when different perturbation codes were used. Thus, the present 1D techniques can be used with confidence for experiment analysis or design studies.

- The method approximation effects (angular quadrature, Legendre Polynomial order, mesh size) are well understood in 1D deep penetration calculations. Here again, an excellent agreement was found among the participants.

- Concerning the uncertainty analysis, it was clear from the data provided and from the discussions held at the meeting that data uncertainties and their correlations are still, to a large extent, lacking. The old Schmidt data are still being used together with the preliminary compilation performed at ORNL by Drischler and Weisbin.

  It seems that in this field the data needs of the shielding community should be stressed in defining priorities in new data file versions (ENDF/B) or in the setting up of new evaluated data files, as it is the case for the Joint Evaluated File (JEF). In particular, data formats and data uncertainty types should fit the needs of transport calculations. The type of uncertainties and of correlations needed for sensitivity analysis as indicated by McCracken at Vienna in 1976 could represent a useful guideline. Moreover, shielding-oriented test problems should be included in the usual physical file checking phases.

The relation of the theoretical benchmark to experimental benchmarks was only partially discussed. In this respect, possible motivations for future specialists' meetings have also been discussed. It was generally agreed that the use of the experimental benchmark to improve shielding design calculations is still a field of high interest. However, the following points should be considered to define appropriate strategies to benefit from the experimental benchmarks:

- According to the conclusions of the present meeting, standard data processing procedures should be defined and their related uncertainty stated.

- Data uncertainty variance-covariance matrix information should be made available in appropriate formats for the major isotopes of interest for shielding (O-16, Na, SS isotopes, etc.) in the principle evaluated data files.

- The present experimental benchmarks (in Fe) should be made available in standard format, including experimental results reduced to 1D models (i.e. with calculated corrections from the actual geometry to 1D model, to be specified), and this to allow a more generalised use of them. Moreover, the new planned experimental benchmark results (propagation in Na, EURACOS), should be made available within a reasonable time delay (mid-1983).

- Data adjustment and consistency procedures should be compared and analysed to define their applicability to shielding design needs.

The above mentioned topics seem to represent the fields in which most progress should be made in the near future, and their discussion, in a reasonable delay of time (about two years), should allow effective progress towards a substantial improvement of the present methods and data used in shielding design calculations and predictions.

PART I

BENCHMARK RESULTS

The data origin of eight data sets used by the participants is the following:

VITAMIN-E : ORNL generated 174 group cross-section data based on ENDF/B-V.

VITAMIN-C : ORNL generated 171 group cross-section data based on ENDF/B-IV.

RADHEAT : 100n - 20 gamma group library, based on ENDF/B-IV (neutrons), and POPOP-4 library ($n \rightarrow \gamma$), processed by the RADHEAT-V3 code system of JAERI.

BABEL : 113n - 36 gamma group library, based on ENDF/B-IV, processed by the MCC2-PN code system, generated at CEA.

PROPANE-D_0 : Shielding formulaire developed with the collaboration of CEA (France) and ENEA (Italy), based on 45 energy group data for neutrons and derived from BABEL.

PROPANE-D_1 : Adjusted version of the previous formulaire, using neutron propagation experiments performed jointly by CEA and ENEA.

EURLIB : EURLIB-3, as used by the UK.

UKAEA : UKNDL processed in 100-group EURLIB structure - Fe weighted with $\phi = [E\Sigma(E)]^{-1}$ and other isotopes with $\phi = E^{-1}$.

The following tables are provided:

TABLES 1-3 : Major response function values as required.

TABLES 4-8 : Sensitivity coefficients in the 15 energy group structure by isotope : Fe, Cr, Ni, Na in lateral shield, Na in Sodium tank. These are region integrated sensitivity coefficients S_a, S_s and S_t for Σabsorption, Σscattering (elastic + inelastic), and for the sum of the two Σ's. The elastic contribution includes only the P_o component. The sensitivity coefficients are for the following responses:

- ϕ_{tot} at mesh 62 and 187.
- ϕ 100 KeV at mesh 62.

TABLE 9 : Sensitivity of ϕ_{tot} at mesh 62 to angular source values.

TABLES 10-19 : 15 group cross-section values (Σ_a and Σ_s) supplied by the different participants.

TABLES 20-44 : Results of the folding cross-section differences obtained from Tables 10-19 with the sensitivity coefficients S_a, S_s and S_t of Tables 4-8. There is one table for each isotope (Fe, Cr, Ni, Na) and one table of summary, and one set of tables for the following cases: (VITAMIN-E)-(BABEL), (RADHEAT)-(BABEL), (VITAMIN-C)-(BABEL), (PROPANE-D1)-(PROPANE-D_0) and (VITAMIN-E)-(VITAMIN-C).

DATA SET	TOTAL FLUX				NA-23(N,GAMMA)			
	MESH 20	MESH 62	MESH 124	MESH 187	MESH 20	MESH 62	MESH 124	MESH 187
VITAM.-C	3.430E+12	6.079E+08	3.836E+06	3.795E+03	5.759E+10	1.766E+07	4.534E+05	7.938E+02
VITAM.-E	3.584E+12	6.736E+08	4.063E+06	3.641E+03	4.522E+10	1.584E+07	4.276E+05	5.884E+02
RADHEAT	3.497E+12	6.001E+08	3.606E+06	3.303E+03	4.504E+10	1.430E+07	3.737E+05	5.208E+02
BABEL	3.200E+12	4.270E+08	2.440E+06	2.100E+03	4.400E+10	1.040E+07	2.320E+05	2.910E+02
PROP.-D0	3.260E+12	4.370E+08	2.620E+06	2.580E+03	4.400E+10	1.060E+07	2.350E+05	3.400E+02
PROP.-D1	3.590E+12	6.230E+08	4.310E+06	5.350E+03	4.810E+10	1.470E+07	3.740E+05	6.730E+02
EURLIB	3.710E+12	1.090E+09	8.300E+06	1.160E+04	4.870E+10	3.050E+07	1.540E+06	3.620E+03
UKAEA	4.060E+12	1.110E+09	1.280E+06	7.940E+03	5.470E+10	2.760E+07	8.070E+05	1.330E+03
MEAN	3.541E+12	6.961E+08	3.807E+06	5.039E+03	4.842E+10	1.770E+07	5.553E+05	1.020E+03
ST. DEV.	2.704E+11	2.643E+08	2.077E+06	3.224E+03	5.133E+09	7.460E+06	4.363E+05	1.099E+03

TABLE 1

DATA SET	FLUX > 100 KEV				DPA			
	MESH 20	MESH 62	MESH 124	MESH 187	MESH 20	MESH 62	MESH 124	MESH 187
VITAM.-C	3.301E+11	1.070E+07	4.644E+01	1.036E-03	1.256E+14	7.957E+09	9.169E+06	1.445E+04
VITAM.-E	3.340E+11	1.117E+07	7.712E+01	3.625E-03	1.276E+14	8.524E+09	8.662E+06	1.185E+04
RADHEAT	3.050E+11	9.725E+06	2.241E+01	3.889E-05	1.479E+14	8.409E+09	7.829E+06	1.077E+04
BABEL	2.580E+11	5.400E+06	1.930E+01	3.910E-04	1.180E+14	5.700E+09	6.240E+06	7.420E+03
PROP.-D0	2.760E+11	6.600E+06	1.640E+01	1.400E-04	1.250E+14	5.950E+09	6.420E+06	8.710E+03
PROP.-D1	3.010E+11	8.700E+06	2.600E+01	2.350E-04	1.370E+14	8.190E+09	1.040E+07	1.730E+04
EURLIB	4.280E+11	2.920E+07	4.970E+01	4.480E-05	1.420E+14	1.650E+10	3.190E+07	7.450E+04
UKAEA	4.030E+11	1.920E+07	2.280E+01	2.150E-05	1.370E+14	1.290E+10	1.670E+07	2.740E+04
MEAN	3.294E+11	1.259E+07	3.502E+01	6.915E-04	1.325E+14	9.266E+09	1.216E+07	2.155E+04
ST. DEV.	5.918E+10	7.893E+06	2.105E+01	1.232E-03	1.004E+13	3.653E+09	8.630E+06	2.230E+04

TABLE 2

DATA SET	THERMAL EQUIVALENT FLUX				CO-59(N,GAMMA)			
	MESH 20	MESH 62	MESH 124	MESH 187	MESH 20	MESH 62	MESH 124	MESH 187
VITAM.-C	7.300E+10	2.995E+07	1.031E+06	1.690E+03	2.162E+13	4.807E+09	3.421E+07	4.283E+04
VITAM.-E	7.482E+10	3.103E+07	9.608E+05	1.364E+03	2.201E+13	5.213E+09	3.721E+07	4.241E+04
RADHEAT	4.585E+09	6.481E+06	4.475E+05	7.156E+02	2.078E+13	4.589E+09	3.322E+07	3.734E+04
BABEL	6.200E+10	1.630E+07	3.870E+05	4.780E+02	1.990E+13	3.410E+09	2.260E+07	2.350E+04
PROP.-D0	6.200E+10	1.700E+07	3.920E+05	5.600E+02	2.020E+13	3.470E+09	2.390E+07	2.760E+04
PROP.-D1	6.720E+10	2.350E+07	6.260E+05	1.110E+03	2.200E+13	4.950E+09	4.060E+07	5.490E+04
EURLIB	7.420E+10	5.250E+07	2.770E+06	6.470E+03	2.180E+13	8.500E+09	1.230E+08	2.570E+05
UKAEA	7.630E+10	4.520E+07	1.460E+06	2.410E+03	2.430E+13	8.620E+09	7.210E+07	9.550E+04
MEAN	6.176E+10	2.774E+07	1.009E+06	1.850E+03	2.158E+13	5.445E+09	4.835E+07	7.264E+04
ST. DEV.	2.379E+10	1.535E+07	8.051E+05	1.975E+03	1.372E+12	2.032E+09	3.383E+07	7.775E+04

TABLE 2 bis

DATA SET	U-235(N,F)				γ-HEATING		n-HEATING	
	MESH 20	MESH 62	MESH 124	MESH 187	MESH 20	MESH 62	MESH 20	MESH 62
VITAM.-C	6.252E+13	1.762E+10	3.682E+08	5.551E+05	1.545E-02	4.585E-06	2.374E-04	2.921E-08
VITAM.-E	6.566E+13	1.981E+10	4.072E+08	5.464E+05	1.568E-02	4.988E-06	2.443E-04	3.229E-08
RADHEAT	6.962E+13	1.952E+10	3.830E+08	5.006E+05	1.354E-02	3.981E-06	1.731E-04	9.596E-09
BABEL	5.440E+13	1.220E+10	2.430E+08	3.010E+05	1.600E-02	3.930E-06	2.270E-04	2.650E-08
PROP.-D0	5.460E+13	1.230E+10	2.460E+08	3.510E+05	1.640E-02	4.000E-06	2.370E-04	2.720E-08
PROP.-D1	5.960E+13	1.730E+10	3.940E+08	6.190E+05	1.750E-02	4.790E-06	2.600E-04	3.810E-08
EURLIB	6.780E+13	3.760E+10	1.620E+09	3.820E+06	0.0	0.0	0.0	0.0
UKAEA	7.210E+13	3.330E+10	8.010E+08	1.270E+06	0.0	0.0	0.0	0.0
MEAN	6.329E+13	2.121E+10	5.578E+08	9.954E+05	1.576E-02	4.379E-06	2.298E-04	2.715E-08
ST. DEV.	6.681E+12	9.323E+09	4.629E+08	1.179E+06	1.306E-03	4.661E-07	2.985E-05	9.583E-09

TABLE 3

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-2.881E-03	-1.161E-01	-1.189E-01	-9.091E-04	-3.003E-02	-3.094E-02	-9.634E-04	-3.223E-02	-3.320E-02
2	-2.636E-03	-3.636E-01	-3.663E-01	-8.370E-04	-9.267E-02	-9.350E-02	-8.867E-04	-9.958E-02	-1.005E-01
3	-2.562E-03	-1.043E+00	-1.045E+00	-7.218E-04	-2.116E-01	-2.123E-01	-7.695E-04	-2.308E-01	-2.315E-01
4	-1.344E-02	-2.419E+00	-2.432E+00	-3.491E-03	-4.558E-01	-4.593E-01	-3.733E-03	-4.988E-01	-5.025E-01
5	-1.015E-02	-1.169E+00	-1.179E+00	-3.506E-03	-2.596E-01	-2.631E-01	-3.705E-03	-2.821E-01	-2.856E-01
6	-1.363E-02	-1.839E+00	-1.853E+00	-5.725E-03	-4.500E-01	-4.557E-01	-6.002E-03	-4.875E-01	-4.935E-01
7	-1.569E-02	-1.803E+00	-1.819E+00	-8.087E-03	-4.771E-01	-4.851E-01	-8.445E-03	-5.159E-01	-5.243E-01
8	-8.328E-04	-2.271E-01	-2.280E-01	-2.197E-03	-1.571E-01	-1.593E-01	-2.238E-03	-1.656E-01	-1.678E-01
9	0.0	0.0	0.0	-7.542E-02	-2.044E+00	-2.120E+00	-7.886E-02	-2.224E+00	-2.303E+00
10	0.0	0.0	0.0	-1.927E-02	-5.062E-01	-5.255E-01	-1.744E-02	-4.919E-01	-5.094E-01
11	0.0	0.0	0.0	-1.678E-02	-2.203E-01	-2.371E-01	-1.459E-02	-2.039E-01	-2.185E-01
12	0.0	0.0	0.0	-2.734E-02	-1.875E-01	-2.149E-01	-2.243E-02	-1.533E-01	-1.758E-01
13	0.0	0.0	0.0	-1.787E-01	-4.301E-01	-6.088E-01	-1.492E-01	-4.360E-01	-5.852E-01
14	0.0	0.0	0.0	-1.704E-01	-4.919E-01	-6.624E-01	-1.182E-01	-3.404E-01	-4.586E-01
15	0.0	0.0	0.0	-1.009E-01	-4.865E-02	-1.496E-01	-1.251E-01	8.510E-02	-4.002E-02
SUM	-6.183E-02	-8.979E+00	-9.041E+00	-6.143E-01	-6.063E+00	-6.677E+00	-5.526E-01	-6.077E+00	-6.630E+00

TABLE 4 - SENSITIVITY COEFFICIENTS FE

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-2.643E-04	-2.873E-02	-2.899E-02	-8.340E-05	-7.480E-03	-7.563E-03	-8.837E-05	-8.023E-03	-8.111E-03
2	-2.842E-04	-1.060E-01	-1.063E-01	-9.023E-05	-2.688E-02	-2.697E-02	-9.559E-05	-2.889E-02	-2.899E-02
3	-1.429E-03	-3.174E-01	-3.188E-01	-4.025E-04	-6.819E-02	-6.859E-02	-4.291E-04	-7.412E-02	-7.454E-02
4	-6.572E-03	-5.245E-01	-5.311E-01	-1.707E-03	-9.808E-02	-9.978E-02	-1.825E-03	-1.073E-01	-1.091E-01
5	-2.234E-03	-5.069E-01	-5.091E-01	-7.715E-04	-1.117E-01	-1.124E-01	-8.152E-04	-1.215E-01	-1.223E-01
6	-2.768E-03	-5.402E-01	-5.430E-01	-1.163E-03	-1.321E-01	-1.332E-01	-1.219E-03	-1.431E-01	-1.443E-01
7	-3.385E-03	-5.848E-01	-5.882E-01	-1.745E-03	-1.508E-01	-1.525E-01	-1.822E-03	-1.633E-01	-1.651E-01
8	-9.670E-05	-4.817E-02	-4.827E-02	-2.552E-04	-3.384E-02	-3.410E-02	-2.598E-04	-3.565E-02	-3.591E-02
9	0.0	0.0	0.0	-2.038E-02	-8.165E-01	-8.369E-01	-2.131E-02	-8.888E-01	-9.101E-01
10	0.0	0.0	0.0	-1.007E-02	-6.134E-02	-7.141E-02	-9.114E-03	-5.896E-02	-6.807E-02
11	0.0	0.0	0.0	-1.888E-02	-5.745E-02	-7.633E-02	-1.641E-02	-5.344E-02	-6.985E-02
12	0.0	0.0	0.0	-5.712E-02	-7.133E-02	-1.285E-01	-4.687E-02	-5.888E-02	-1.057E-01
13	0.0	0.0	0.0	-1.701E-02	-5.302E-02	-7.003E-02	-1.420E-02	-5.339E-02	-6.759E-02
14	0.0	0.0	0.0	-5.605E-02	-5.195E-02	-1.080E-01	-3.886E-02	-3.615E-02	-7.501E-02
15	0.0	0.0	0.0	-3.224E-02	-4.959E-03	-3.720E-02	-3.991E-02	8.702E-03	-3.121E-02
SUM	-1.703E-02	-2.657E+00	-2.674E+00	-2.180E-01	-1.746E+00	-1.964E+00	-1.932E-01	-1.823E+00	-2.016E+00

TABLE 5 - SENSITIVITY COEFFICIENTS CR

GROUP	FAST FLUX 62 ABSORPT.	FAST FLUX 62 SCATTER.	FAST FLUX 62 TOTAL	TOTAL FLUX 62 ABSORPT.	TOTAL FLUX 62 SCATTER.	TOTAL FLUX 62 TOTAL	TOTAL FLUX 187 ABSORPT.	TOTAL FLUX 187 SCATTER.	TOTAL FLUX 187 TOTAL
1	-3.726E-03	-1.320E-02	-1.692E-02	-1.176E-03	-3.468E-03	-4.643E-03	-1.246E-03	-3.719E-03	-4.965E-03
2	-5.305E-03	-4.830E-02	-5.360E-02	-1.685E-03	-1.220E-02	-1.388E-02	-1.785E-03	-1.312E-02	-1.491E-02
3	-3.936E-03	-1.368E-01	-1.408E-01	-1.109E-03	-2.971E-02	-3.081E-02	-1.182E-03	-3.226E-02	-3.344E-02
4	-3.909E-03	-2.496E-01	-2.535E-01	-1.015E-03	-4.531E-02	-4.632E-02	-1.085E-03	-4.963E-02	-5.072E-02
5	-1.981E-03	-2.117E-01	-2.137E-01	-6.841E-04	-4.745E-02	-4.814E-02	-7.228E-04	-5.154E-02	-5.226E-02
6	-2.858E-03	-2.168E-01	-2.197E-01	-1.200E-03	-5.455E-02	-5.575E-02	-1.258E-03	-5.896E-02	-6.021E-02
7	-3.352E-03	-5.315E-01	-5.348E-01	-1.727E-03	-1.362E-01	-1.379E-01	-1.804E-03	-1.475E-01	-1.493E-01
8	-1.822E-04	-6.743E-02	-6.761E-02	-4.807E-04	-4.683E-02	-4.731E-02	-4.896E-04	-4.934E-02	-4.983E-02
9	0.0	0.0	0.0	-2.105E-02	-7.866E-01	-8.077E-01	-2.201E-02	-8.600E-01	-8.820E-01
10	0.0	0.0	0.0	-7.763E-03	-7.664E-02	-8.440E-02	-7.027E-03	-7.409E-02	-8.111E-02
11	0.0	0.0	0.0	-1.302E-02	-4.289E-01	-4.419E-01	-1.132E-02	-4.035E-01	-4.148E-01
12	0.0	0.0	0.0	-1.600E-02	-6.434E-02	-8.034E-02	-1.313E-02	-5.294E-02	-6.607E-02
13	0.0	0.0	0.0	-1.124E-02	-9.189E-02	-1.031E-01	-9.389E-03	-9.252E-02	-1.019E-01
14	0.0	0.0	0.0	-4.034E-02	-9.946E-02	-1.398E-01	-2.798E-02	-6.854E-02	-9.652E-02
15	0.0	0.0	0.0	-2.352E-02	-1.004E-02	-3.355E-02	-2.921E-02	1.770E-02	-1.151E-02
SUM	-2.525E-02	-1.475E+00	-1.501E+00	-1.420E-01	-1.934E+00	-2.076E+00	-1.296E-01	-1.940E+00	-2.070E+00

TABLE 6 - SENSITIVITY COEFFICIENTS NI

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-5.547E-04	-1.755E-02	-1.810E-02	-1.750E-04	-4.537E-03	-4.712E-03	-1.855E-04	-4.869E-03	-5.054E-03
2	-1.904E-05	-8.034E-02	-8.036E-02	-6.045E-06	-2.054E-02	-2.054E-02	-6.404E-06	-2.206E-02	-2.207E-02
3	-6.910E-05	-2.777E-01	-2.777E-01	-1.947E-05	-5.754E-02	-5.756E-02	-2.075E-05	-6.262E-02	-6.264E-02
4	-2.998E-04	-1.624E+00	-1.624E+00	-7.785E-05	-2.714E-01	-2.714E-01	-8.323E-05	-2.997E-01	-2.998E-01
5	-2.224E-04	-1.147E+00	-1.147E+00	-7.681E-05	-2.488E-01	-2.489E-01	-8.116E-05	-2.713E-01	-2.714E-01
6	-2.414E-04	-7.498E-01	-7.500E-01	-1.014E-04	-1.777E-01	-1.778E-01	-1.063E-04	-1.931E-01	-1.932E-01
7	-4.834E-04	-1.471E+00	-1.471E+00	-2.492E-04	-3.724E-01	-3.727E-01	-2.602E-04	-4.038E-01	-4.041E-01
8	-3.544E-05	-1.142E-01	-1.142E-01	-9.353E-05	-7.197E-02	-7.206E-02	-9.524E-05	-7.594E-02	-7.604E-02
9	0.0	0.0	0.0	-3.311E-03	-1.247E+00	-1.250E+00	-3.462E-03	-1.364E+00	-1.368E+00
10	0.0	0.0	0.0	-1.678E-03	-1.327E-01	-1.344E-01	-1.519E-03	-1.290E-01	-1.305E-01
11	0.0	0.0	0.0	-1.549E-04	-1.329E-01	-1.331E-01	-1.347E-04	-1.246E-01	-1.247E-01
12	0.0	0.0	0.0	-8.140E-03	-1.204E-01	-1.286E-01	-6.678E-03	-9.845E-02	-1.051E-01
13	0.0	0.0	0.0	-7.713E-03	-6.763E-02	-7.534E-02	-6.491E-03	-7.070E-02	-7.719E-02
14	0.0	0.0	0.0	-1.240E-02	-6.704E-02	-7.944E-02	-1.253E-02	-4.391E-02	-5.644E-02
15	0.0	0.0	0.0	-6.873E-03	-4.390E-03	-1.126E-02	-4.776E-02	5.376E-02	6.003E-03
SUM	-1.925E-03	-5.481E+00	-5.483E+00	-4.107E-02	-2.997E+00	-3.038E+00	-7.941E-02	-3.111E+00	-3.190E+00

TABLE 7 - SENSITIVITY COEFFICIENTS NA IN LATERAL SHIELD

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-2.482E-08	3.756E-07	3.508E-07	-1.981E-10	1.607E-09	1.409E-09	-2.933E-09	-2.986E-08	-3.280E-08
2	-1.116E-09	4.908E-06	4.907E-06	-9.015E-12	1.859E-08	1.858E-08	-8.018E-11	-2.615E-07	-2.615E-07
3	-8.178E-08	3.387E-04	3.386E-04	-6.805E-10	1.237E-06	1.236E-06	-4.303E-09	-1.246E-05	-1.247E-05
4	-3.085E-06	6.292E-03	6.289E-03	-2.418E-08	2.226E-05	2.224E-05	-7.578E-08	-1.271E-04	-1.272E-04
5	-5.629E-06	5.631E-03	5.626E-03	-4.619E-08	2.482E-05	2.477E-05	-1.358E-07	-1.385E-04	-1.386E-04
6	-2.240E-05	1.981E-02	1.979E-02	-2.344E-07	1.695E-04	1.693E-04	-9.113E-07	-1.286E-03	-1.287E-03
7	-8.733E-05	1.052E-02	1.043E-02	-1.475E-06	6.047E-04	6.033E-04	-4.770E-06	-3.514E-03	-3.519E-03
8	-3.844E-05	-8.203E-02	-8.206E-02	-1.491E-06	4.422E-04	4.407E-04	-5.281E-06	-2.892E-03	-2.697E-03
9	0.0	0.0	0.0	-1.584E-04	2.350E-02	2.334E-02	-5.269E-04	-1.567E-01	-1.572E-01
10	0.0	0.0	0.0	-5.468E-04	1.385E-02	1.330E-02	-1.796E-03	-1.174E-01	-1.192E-01
11	0.0	0.0	0.0	-6.225E-05	2.339E-02	2.332E-02	-1.997E-04	-1.589E-01	-1.591E-01
12	0.0	0.0	0.0	-3.447E-03	-5.932E-04	-4.040E-03	-9.831E-03	-8.991E-02	-9.974E-02
13	0.0	0.0	0.0	-9.323E-03	4.068E-02	3.136E-02	-6.668E-02	-1.268E+00	-1.334E+00
14	0.0	0.0	0.0	-2.588E-02	4.277E-02	1.689E-02	-3.790E-01	-3.953E+00	-4.332E+00
15	0.0	0.0	0.0	-9.020E-02	3.537E-02	-5.483E-02	-2.182E+00	-1.766E+00	-3.948E+00
SUM	-1.570E-04	-3.942E-02	-3.958E-02	-1.296E-01	1.802E-01	5.060E-02	-2.640E+00	-7.517E+00	-1.016E+01

TABLE 8 - SENSITIVITY COEFFICIENTS NA IN NA TANK

SENSITIVITY TO ANGULAR SOURCE IN POINT 1

GRP.	ANGLE	N = 1	N = 2	N = 3	N = 4	N = 5
1	0.0		1.92608E-06	9.87623E-06	8.42146E-03	1.95898E-02
2	0.0		9.68038E-06	3.44461E-05	2.67781E-02	6.10190E-02
3	0.0		1.94790E-05	5.50621E-05	4.37362E-02	1.00602E-01
4	0.0		3.37812E-05	9.37240E-05	6.71297E-02	1.51196E-01
5	0.0		1.59807E-05	4.37996E-05	3.56493E-02	8.39731E-02
6	0.0		1.83782E-05	4.51470E-05	2.85132E-02	6.35739E-02
7	0.0		1.39681E-05	3.24735E-05	2.29151E-02	5.28771E-02
8	0.0		2.94015E-06	7.07782E-06	5.17792E-03	1.23423E-02
9	0.0		6.15669E-05	1.28221E-04	6.66926E-02	1.46856E-01
10	0.0		1.38050E-06	2.75709E-06	1.04846E-03	2.31255E-03
11	0.0		6.49548E-07	1.28600E-06	4.88885E-04	1.08747E-03
12	0.0		3.79978E-07	7.36335E-07	1.44111E-04	3.04646E-04
13	0.0		8.51765E-08	1.65973E-07	3.98189E-05	8.50652E-05
14	0.0		3.25830E-09	6.33458E-09	1.40113E-06	2.98325E-06
15	0.0		8.98734E-13	1.74242E-12	3.78065E-10	8.19169E-10

TABLE 9 - SENSITIVITY TO THE SOURCE

DATA SET	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
VITAM.-C	4.327E-02	1.041E-02	2.533E-03	3.699E-03	5.156E-03	4.971E-03	5.047E-03	5.329E-03
VITAM.-E	4.344E-02	1.057E-02	2.632E-03	4.840E-03	6.339E-03	4.684E-03	3.685E-03	4.159E-03
RADHEAT	4.716E-04	8.598E-04	1.590E-03	3.861E-03	5.142E-03	4.952E-03	5.047E-03	5.328E-03
BABEL	4.251E-02	9.581E-03	2.404E-03	3.861E-03	5.144E-03	4.948E-03	5.041E-03	5.324E-03
PROP.-D0	3.401E-02	6.269E-03	2.153E-03	3.865E-03	5.142E-03	4.946E-03	5.045E-03	5.323E-03
PROP.-D1	3.374E-02	6.255E-03	2.149E-03	3.857E-03	5.126E-03	4.922E-03	5.012E-03	5.258E-03
EURLIB	4.327E-02	9.614E-03	2.396E-03	3.881E-03	5.145E-03	4.950E-03	5.048E-03	5.349E-03
UKAEA	4.244E-02	8.201E-03	2.409E-03	4.058E-03	5.242E-03	4.983E-03	4.474E-03	3.574E-03
MEAN	3.539E-02	7.720E-03	2.283E-03	3.990E-03	5.305E-03	4.920E-03	4.800E-03	4.955E-03
ST. DEV.	1.470E-02	3.251E-03	3.256E-04	3.566E-04	4.195E-04	9.682E-05	4.924E-04	6.907E-04

TABLE 10 - Fe σ_a

DATA SET	GROUP 9	GROUP 10	GROUP 11	GROUP 12	GROUP 13	GROUP 14	GROUP 15
VITAM.-C	7.027E-03	8.272E-03	7.711E-03	1.291E-02	5.205E-02	5.942E-02	2.487E-01
VITAM.-E	6.301E-03	7.617E-03	8.548E-03	1.035E-02	4.390E-02	5.713E-02	2.492E-01
RADHEAT	7.159E-03	5.625E-03	8.699E-03	1.225E-02	4.418E-02	5.912E-02	2.492E-01
BABEL	7.036E-03	9.628E-03	8.161E-03	1.308E-02	6.689E-02	5.917E-02	2.456E-01
PROP.-D0	7.042E-03	1.054E-02	6.670E-03	1.247E-02	7.667E-02	6.325E-02	2.728E-01
PROP.-D1	7.009E-03	1.044E-02	6.645E-03	1.210E-02	6.791E-02	6.296E-02	2.728E-01
EURLIB	7.047E-03	7.818E-03	6.410E-03	1.193E-02	4.634E-02	5.896E-02	2.334E-01
UKAEA	7.244E-03	7.045E-03	5.959E-03	9.173E-03	3.829E-02	5.686E-02	2.320E-01
MEAN	6.983E-03	8.373E-03	7.350E-03	1.178E-02	5.453E-02	5.961E-02	2.505E-01
ST. DEV.	2.872E-04	1.721E-03	1.057E-03	1.342E-03	1.404E-02	2.363E-03	1.539E-02

TABLE 10 (contd.) - Fe σ_a

DATA SET	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
VITAM.-C	3.598E+00	3.394E+00	2.920E+00	2.725E+00	1.936E+00	3.262E+00	2.550E+00	2.798E+00
VITAM.-E	3.597E+00	3.394E+00	2.926E+00	2.735E+00	1.936E+00	3.270E+00	2.562E+00	2.615E+00
RADHEAT	3.642E+00	3.448E+00	2.879E+00	2.688E+00	2.033E+00	3.326E+00	2.575E+00	2.727E+00
BABEL	3.602E+00	3.457E+00	2.951E+00	2.878E+00	2.213E+00	3.537E+00	2.805E+00	2.894E+00
PROP.-D0	3.594E+00	3.300E+00	2.912E+00	2.835E+00	2.225E+00	3.556E+00	2.788E+00	2.872E+00
PROP.-D1	3.585E+00	3.285E+00	2.907E+00	2.829E+00	2.217E+00	3.543E+00	2.776E+00	2.864E+00
EURLIB	3.596E+00	3.423E+00	2.756E+00	2.387E+00	1.732E+00	2.994E+00	1.807E+00	2.077E+00
UKAEA	3.605E+00	3.469E+00	2.999E+00	2.611E+00	1.692E+00	2.998E+00	1.785E+00	2.462E+00
MEAN	3.602E+00	3.396E+00	2.906E+00	2.711E+00	2.004E+00	3.311E+00	2.456E+00	2.664E+00
ST. DEV.	1.790E-02	7.010E-02	7.033E-02	1.574E-01	2.051E-01	2.292E-01	4.210E-01	2.792E-01

TABLE 11 - Fe σ_s

DATA SET	GROUP 9	GROUP 10	GROUP 11	GROUP 12	GROUP 13	GROUP 14	GROUP 15
VITAM.-C	3.429E+00	5.623E+00	3.468E+00	7.053E+00	9.978E+00	1.138E+01	1.140E+01
VITAM.-E	3.339E+00	5.616E+00	3.504E+00	7.015E+00	9.890E+00	1.136E+01	1.141E+01
RADHEAT	3.463E+00	5.707E+00	5.860E+00	7.045E+00	9.974E+00	1.138E+01	1.140E+01
BABEL	3.471E+00	5.644E+00	3.655E+00	6.909E+00	9.975E+00	1.138E+01	1.140E+01
PROP.-D0	3.450E+00	7.365E+00	1.271E+00	7.143E+00	1.013E+01	1.137E+01	1.140E+01
PROP.-D1	3.448E+00	7.271E+00	1.249E+00	7.017E+00	1.007E+01	1.136E+01	1.140E+01
EURLIB	2.718E+00	5.779E+00	3.597E+00	6.791E+00	9.975E+00	1.137E+01	1.139E+01
UKAEA	2.598E+00	5.230E+00	3.722E+00	7.015E+00	9.474E+00	1.108E+01	1.134E+01
MEAN	3.239E+00	6.029E+00	3.291E+00	6.998E+00	9.933E+00	1.133E+01	1.139E+01
ST. DEV.	3.628E-01	8.120E-01	1.480E+00	1.056E-01	1.990E-01	1.021E-01	2.287E-02

TABLE 11 (contd.) - Fe σ_S

DATA SET	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
VITAM.-C	1.663E-02	3.941E-03	4.907E-03	7.125E-03	4.464E-03	3.804E-03	3.781E-03	2.232E-03
VITAM.-E	3.945E-02	7.001E-03	5.085E-03	2.296E-02	9.904E-03	3.792E-03	3.772E-03	2.207E-03
RADHEAT	7.867E-04	2.423E-03	4.959E-03	7.017E-03	4.119E-03	3.721E-03	3.797E-03	2.276E-03
BABEL	1.451E-02	3.843E-03	4.987E-03	7.023E-03	4.212E-03	3.739E-03	4.047E-03	2.300E-03
PROP.-D0	1.143E-02	3.535E-03	5.432E-03	7.005E-03	4.205E-03	3.737E-03	4.059E-03	2.283E-03
PROP.-D1	1.135E-02	3.532E-03	5.420E-03	6.994E-03	4.194E-03	3.723E-03	4.033E-03	2.258E-03
EURLIB	1.660E-02	3.844E-03	4.991E-03	7.014E-03	4.209E-03	3.738E-03	4.026E-03	2.418E-03
UKAEA	7.377E-03	1.616E-03	2.088E-03	3.554E-03	3.366E-03	3.179E-03	4.811E-03	3.879E-03
MEAN	1.477E-02	3.717E-03	4.734E-03	8.587E-03	4.836E-03	3.679E-03	4.041E-03	2.482E-03
ST. DEV.	1.127E-02	1.559E-03	1.089E-03	5.934E-03	2.071E-03	2.043E-04	3.368E-04	5.682E-04

TABLE 12 - Cr σ_a

DATA SET	GROUP 9	GROUP 10	GROUP 11	GROUP 12	GROUP 13	GROUP 14	GROUP 15
VITAM.-C	6.991E-03	1.867E-02	3.208E-02	8.934E-02	2.396E-02	7.254E-02	3.010E-01
VITAM.-E	6.867E-03	1.859E-02	3.207E-02	8.733E-02	2.387E-02	7.266E-02	3.029E-01
RADHEAT	6.896E-03	1.796E-02	3.108E-02	7.361E-02	2.378E-02	7.235E-02	3.039E-01
BABEL	7.075E-03	1.872E-02	3.417E-02	1.017E-01	2.369E-02	7.241E-02	2.920E-01
PROP.-D0	7.103E-03	1.999E-02	3.421E-02	9.025E-02	2.358E-02	7.735E-02	3.232E-01
PROP.-D1	6.674E-03	1.736E-02	2.816E-02	7.635E-02	2.138E-02	7.427E-02	3.165E-01
EURLIB	7.548E-03	2.043E-02	3.542E-02	1.064E-01	2.378E-02	7.226E-02	2.836E-01
UKAEA	7.278E-03	9.760E-03	1.613E-02	7.504E-02	3.083E-02	7.020E-02	2.800E-01
MEAN	7.054E-03	1.768E-02	3.041E-02	8.750E-02	2.436E-02	7.300E-02	3.004E-01
ST. DEV.	2.685E-04	3.353E-03	6.193E-03	1.220E-02	2.748E-03	2.073E-03	1.495E-02

TABLE 12 (Contd.) - Cr σ_a

DATA SET	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
VITAM.-C	3.616E+00	3.736E+00	3.293E+00	2.943E+00	3.151E+00	3.837E+00	2.434E+00	2.351E+00
VITAM.-E	3.595E+00	3.733E+00	3.298E+00	2.944E+00	2.927E+00	3.841E+00	2.432E+00	2.348E+00
RADHEAT	3.633E+00	3.706E+00	3.291E+00	2.865E+00	3.340E+00	3.799E+00	2.410E+00	2.358E+00
BABEL	3.619E+00	3.709E+00	3.278E+00	2.897E+00	3.397E+00	3.848E+00	2.686E+00	2.405E+00
PROP.-D0	3.659E+00	3.665E+00	3.219E+00	2.895E+00	3.388E+00	3.870E+00	2.676E+00	2.402E+00
PROP.-D1	3.588E+00	3.587E+00	2.899E+00	2.792E+00	3.269E+00	3.496E+00	2.530E+00	2.288E+00
EURLIB	3.616E+00	3.711E+00	3.328E+00	2.928E+00	3.441E+00	3.918E+00	2.618E+00	2.404E+00
UKAEA	3.599E+00	3.678E+00	3.168E+00	2.874E+00	2.956E+00	3.013E+00	2.679E+00	2.029E+00
MEAN	3.616E+00	3.690E+00	3.222E+00	2.892E+00	3.233E+00	3.703E+00	2.558E+00	2.323E+00
ST. DEV.	2.320E-02	4.861E-02	1.399E-01	5.033E-02	2.015E-01	3.072E-01	1.208E-01	1.254E-01

TABLE 13 - Cr σ_S

DATA SET	GROUP 9	GROUP 10	GROUP 11	GROUP 12	GROUP 13	GROUP 14	GROUP 15
VITAM.-C	4.898E+00	4.540E+00	3.016E+00	1.374E+01	4.818E+00	4.382E+00	4.344E+00
VITAM.-E	4.885E+00	4.603E+00	3.014E+00	1.372E+01	4.790E+00	4.377E+00	4.353E+00
RADHEAT	4.854E+00	4.517E+00	3.339E+00	1.335E+01	4.784E+00	4.371E+00	4.339E+00
BABEL	4.956E+00	4.037E+00	3.000E+00	1.388E+01	4.783E+00	4.371E+00	4.337E+00
PROP.-D0	4.917E+00	4.031E+00	2.928E+00	1.262E+01	4.679E+00	4.372E+00	4.334E+00
PROP.-D1	4.728E+00	3.930E+00	2.863E+00	1.241E+01	4.623E+00	4.342E+00	4.315E+00
EURLIB	5.667E+00	5.866E+00	3.108E+00	1.321E+01	4.784E+00	4.370E+00	4.344E+00
UKAEA	4.696E+00	4.359E+00	3.080E+00	9.932E+00	4.280E+00	4.265E+00	4.186E+00
MEAN	4.950E+00	4.485E+00	3.043E+00	1.286E+01	4.693E+00	4.356E+00	4.319E+00
ST. DEV.	3.035E-01	6.159E-01	1.426E-01	1.294E+00	1.794E-01	3.906E-02	5.520E-02

TABLE 13 (contd) - Cr σS

DATA SET	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
VITAM.-C	4.168E-01	1.577E-01	3.030E-02	8.606E-03	7.588E-03	7.808E-03	8.200E-03	9.073E-03
VITAM.-E	4.112E-01	1.599E-01	2.707E-02	8.518E-03	7.783E-03	7.792E-03	8.176E-03	8.994E-03
RADHEAT	9.906E-04	2.510E-03	5.562E-03	7.548E-03	7.536E-03	7.827E-03	8.176E-03	9.112E-03
BABEL	4.158E-01	1.459E-01	2.794E-02	8.493E-03	7.593E-03	7.847E-03	8.146E-03	8.812E-03
PROP.-D0	3.601E-01	9.874E-02	2.122E-02	8.409E-03	7.593E-03	7.861E-03	8.159E-03	8.799E-03
PROP.-D1	3.580E-01	9.832E-02	2.115E-02	8.359E-03	7.553E-03	7.813E-03	8.091E-03	8.706E-03
EURLIB	4.165E-01	1.460E-01	2.780E-02	8.478E-03	7.548E-03	7.820E-03	8.146E-03	9.067E-03
UKAEA	4.336E-01	1.623E-01	3.173E-02	7.573E-03	7.633E-03	7.940E-03	8.306E-03	9.196E-03
MEAN	3.516E-01	1.214E-01	2.410E-02	8.248E-03	7.604E-03	7.839E-03	8.175E-03	8.970E-03
ST. DEV.	1.444E-01	5.459E-02	8.405E-03	4.307E-04	7.887E-05	4.650E-05	6.238E-05	1.758E-04

TABLE 14 - Ni σ_a

DATA SET	GROUP 9	GROUP 10	GROUP 11	GROUP 12	GROUP 13	GROUP 14	GROUP 15
VITAM.-C	1.456E-02	2.727E-02	4.543E-02	5.523E-02	3.204E-02	1.065E-01	4.440E-01
VITAM.-E	1.443E-02	2.711E-02	4.523E-02	5.472E-02	3.205E-02	1.063E-01	4.460E-01
RADHEAT	1.460E-02	2.619E-02	4.161E-02	5.398E-02	3.196E-02	1.058E-01	4.473E-01
BABEL	1.485E-02	2.935E-02	4.792E-02	5.790E-02	3.184E-02	1.059E-01	4.330E-01
PROP.-D0	1.487E-02	3.051E-02	4.883E-02	5.359E-02	3.181E-02	1.132E-01	4.799E-01
PROP.-D1	1.483E-02	3.038E-02	4.864E-02	5.350E-02	3.168E-02	1.125E-01	4.784E-01
EURLIB	1.455E-02	3.120E-02	5.022E-02	5.851E-02	3.196E-02	1.056E-01	4.171E-01
UKAEA	1.354E-02	2.741E-02	3.423E-02	5.392E-02	3.074E-02	1.005E-01	4.023E-01
MEAN	1.453E-02	2.868E-02	4.526E-02	5.517E-02	3.176E-02	1.071E-01	4.435E-01
ST. DEV.	4.334E-04	1.899E-03	5.221E-03	1.968E-03	4.291E-04	4.062E-03	2.690E-02

TABLE 14 (contd.) - Ni σ_a

DATA SET	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
VITAM.-C	3.234E+00	3.132E+00	2.979E+00	2.788E+00	3.255E+00	3.730E+00	4.562E+00	6.554E+00
VITAM.-E	3.273E+00	3.183E+00	3.091E+00	2.972E+00	3.269E+00	3.727E+00	4.567E+00	6.518E+00
RADHEAT	3.651E+00	3.257E+00	3.004E+00	2.845E+00	3.130E+00	3.836E+00	4.515E+00	6.592E+00
BABEL	3.236E+00	3.113E+00	2.979E+00	2.841E+00	3.203E+00	3.943E+00	4.641E+00	6.586E+00
PROP.-D0	3.221E+00	3.069E+00	2.979E+00	2.835E+00	3.190E+00	3.957E+00	4.661E+00	6.573E+00
PROP.-D1	3.197E+00	3.043E+00	2.904E+00	2.800E+00	3.149E+00	3.906E+00	4.531E+00	6.170E+00
EURLIB	3.235E+00	3.114E+00	2.987E+00	2.844E+00	3.179E+00	3.884E+00	4.588E+00	6.656E+00
UKAEA	3.195E+00	3.103E+00	3.279E+00	3.205E+00	3.200E+00	3.897E+00	4.618E+00	6.698E+00
MEAN	3.280E+00	3.127E+00	3.025E+00	2.891E+00	3.197E+00	3.860E+00	4.585E+00	6.543E+00
ST. DEV.	1.518E-01	6.688E-02	1.147E-01	1.382E-01	4.754E-02	8.922E-02	5.182E-02	1.615E-01

TABLE 15 - Ni σ_S

DATA SET	GROUP 9	GROUP 10	GROUP 11	GROUP 12	GROUP 13	GROUP 14	GROUP 15
VITAM.-C	6.302E+00	7.862E+00	2.449E+01	2.250E+01	1.698E+01	1.777E+01	1.785E+01
VITAM.-E	6.274E+00	7.840E+00	2.444E+01	2.251E+01	1.692E+01	1.776E+01	1.789E+01
RADHEAT	6.281E+00	7.322E+00	2.177E+01	2.208E+01	1.689E+01	1.775E+01	1.786E+01
BABEL	6.230E+00	8.256E+00	2.649E+01	2.296E+01	1.689E+01	1.775E+01	1.785E+01
PROP.-D0	6.208E+00	8.697E+00	2.838E+01	2.207E+01	1.699E+01	1.775E+01	1.785E+01
PROP.-D1	5.446E+00	8.261E+00	2.717E+01	2.143E+01	1.674E+01	1.761E+01	1.774E+01
EURLIB	6.386E+00	7.843E+00	2.614E+01	2.264E+01	1.689E+01	1.775E+01	1.786E+01
UKAEA	7.387E+00	8.937E+00	2.401E+01	2.009E+01	1.572E+01	1.720E+01	1.743E+01
MEAN	6.314E+00	8.127E+00	2.536E+01	2.204E+01	1.675E+01	1.767E+01	1.779E+01
ST. DEV.	5.253E-01	5.205E-01	2.090E+00	9.105E-01	4.248E-01	1.966E-01	1.543E-01

TABLE 15 (contd.) - Ni σ_S

DATA SET	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
VITAM.-C	2.532E-02	2.177E-04	1.982E-04	2.549E-04	3.471E-04	2.792E-04	4.807E-04	6.938E-04
VITAM.-E	2.537E-02	2.174E-04	1.979E-04	2.538E-04	3.463E-04	3.224E-04	4.193E-04	8.297E-04
RADHEAT	1.642E-04	1.717E-04	1.986E-04	2.640E-04	3.449E-04	2.699E-04	4.727E-04	6.937E-04
BABEL	2.506E-02	2.119E-04	1.985E-04	2.636E-04	3.451E-04	2.684E-04	4.756E-04	6.939E-04
PROP.-D0	1.749E-02	1.779E-04	2.018E-04	2.615E-04	3.449E-04	2.668E-04	4.820E-04	6.940E-04
PROP.-D1	1.704E-02	1.766E-04	2.014E-04	2.615E-04	3.448E-04	2.661E-04	4.791E-04	6.899E-04
EURLIB	2.519E-02	2.118E-04	1.986E-04	2.642E-04	3.450E-04	2.703E-04	4.703E-04	6.937E-04
UKAEA	1.818E-02	1.410E-04	1.357E-04	2.278E-04	3.177E-04	3.980E-04	5.321E-04	6.071E-04
MEAN	1.923E-02	1.907E-04	1.913E-04	2.564E-04	3.420E-04	2.926E-04	4.765E-04	6.995E-04
ST. DEV.	8.592E-03	2.811E-05	2.254E-05	1.225E-05	9.850E-06	4.651E-05	3.041E-05	6.065E-05

TABLE 16 - Na in Lat. Sh. σ_a

DATA SET	GROUP 9	GROUP 10	GROUP 11	GROUP 12	GROUP 13	GROUP 14	GROUP 15
VITAM.-C	9.161E-04	2.760E-03	2.308E-04	1.304E-02	8.878E-03	1.323E-02	5.191E-02
VITAM.-E	6.388E-04	1.934E-03	2.611E-05	9.667E-03	6.506E-03	1.278E-02	5.162E-02
RADHEAT	8.197E-04	2.484E-03	2.297E-04	1.448E-02	8.845E-03	1.318E-02	5.254E-02
BABEL	9.459E-04	2.568E-03	2.307E-04	1.192E-02	8.841E-03	1.319E-02	5.122E-02
PROP.-D0	9.636E-04	2.299E-03	2.314E-04	1.177E-02	8.179E-03	1.406E-02	5.689E-02
PROP.-D1	9.534E-04	2.282E-03	2.299E-04	1.167E-02	8.125E-03	1.402E-02	5.690E-02
EURLIB	9.221E-04	8.465E-03	2.305E-04	1.540E-02	8.855E-03	1.314E-02	4.870E-02
UKAEA	9.721E-04	1.598E-03	2.297E-03	1.934E-02	6.259E-03	1.278E-02	4.888E-02
MEAN	8.915E-04	3.049E-03	4.633E-04	1.341E-02	8.061E-03	1.330E-02	5.233E-02
ST. DEV.	1.128E-04	2.219E-03	7.445E-04	2.985E-03	1.083E-03	4.930E-04	3.133E-03

TABLE 16 (contd.) Na in Lat. Sh. σ_α

DATA SET	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
VITAM.-C	1.798E+00	2.262E+00	2.708E+00	4.491E+00	5.042E+00	3.040E+00	3.468E+00	3.064E+00
VITAM.-E	1.877E+00	2.349E+00	2.788E+00	4.619E+00	5.199E+00	3.106E+00	3.570E+00	2.932E+00
RADHEAT	1.825E+00	2.345E+00	2.704E+00	4.814E+00	4.386E+00	2.927E+00	3.505E+00	2.983E+00
BABEL	1.799E+00	2.346E+00	2.703E+00	4.808E+00	4.387E+00	2.953E+00	3.488E+00	3.076E+00
PROP.-D0	1.905E+00	2.592E+00	2.653E+00	4.737E+00	4.380E+00	2.957E+00	3.477E+00	3.061E+00
PROP.-D1	1.883E+00	2.556E+00	2.619E+00	4.666E+00	4.290E+00	2.893E+00	3.406E+00	2.998E+00
EURLIB	1.799E+00	2.348E+00	2.712E+00	4.848E+00	4.388E+00	2.957E+00	3.509E+00	3.056E+00
UKAEA	1.741E+00	2.365E+00	2.692E+00	5.004E+00	4.632E+00	2.992E+00	3.502E+00	3.011E+00
MEAN	1.828E+00	2.395E+00	2.697E+00	4.748E+00	4.588E+00	2.978E+00	3.491E+00	3.023E+00
ST. DEV.	5.540E-02	1.151E-01	4.910E-02	1.572E-01	3.455E-01	6.740E-02	4.631E-02	5.050E-02

TABLE 17 - Na in Lat. Sh. σ_S

DATA SET	GROUP 9	GROUP 10	GROUP 11	GROUP 12	GROUP 13	GROUP 14	GROUP 15
VITAM.-C	3.687E+00	4.577E+00	4.031E+00	1.381E+01	3.634E+00	3.141E+00	3.171E+00
VITAM.-E	3.697E+00	4.686E+00	4.215E+00	1.306E+01	3.633E+00	3.145E+00	3.172E+00
RADHEAT	3.680E+00	4.595E+00	3.983E+00	1.427E+01	3.623E+00	3.142E+00	3.160E+00
BABEL	3.668E+00	4.459E+00	4.032E+00	1.345E+01	3.623E+00	3.142E+00	3.163E+00
PROP.-D0	3.665E+00	4.432E+00	4.054E+00	1.213E+01	3.396E+00	3.143E+00	3.170E+00
PROP.-D1	3.550E+00	4.152E+00	3.744E+00	1.149E+01	3.209E+00	3.025E+00	3.173E+00
EURLIB	3.688E+00	4.923E+00	4.020E+00	1.507E+01	3.625E+00	3.142E+00	3.158E+00
UKAEA	3.654E+00	4.606E+00	4.184E+00	1.207E+01	3.380E+00	3.105E+00	3.160E+00
MEAN	3.661E+00	4.554E+00	4.033E+00	1.317E+01	3.515E+00	3.123E+00	3.166E+00
ST. DEV.	4.754E-02	2.218E-01	1.428E-01	1.222E+00	1.645E-01	4.184E-02	6.766E-03

TABLE 17 (contd.) - Na in Lat. Sh. σ_s

DATA SET	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
VITAM.-C	6.397E-02	2.011E-04	2.052E-04	2.664E-04	3.474E-04	2.691E-04	5.229E-04	6.938E-04
VITAM.-E	6.784E-02	2.023E-04	2.055E-04	2.646E-04	3.462E-04	3.175E-04	3.794E-04	4.419E-04
RADHEAT	1.685E-04	1.734E-04	2.048E-04	2.731E-04	3.439E-04	2.657E-04	5.135E-04	6.942E-04
BABEL	5.669E-02	1.957E-04	2.045E-04	2.728E-04	3.438E-04	2.646E-04	4.995E-04	6.940E-04
PROP.-D0	3.578E-02	1.771E-04	2.045E-04	2.651E-04	3.439E-04	2.629E-04	4.923E-04	6.939E-04
PROP.-D1	3.331E-02	1.760E-04	2.043E-04	2.651E-04	3.439E-04	2.627E-04	4.921E-04	6.924E-04
EURLIB	6.279E-02	1.953E-04	2.051E-04	2.739E-04	3.443E-04	2.652E-04	5.155E-04	6.937E-04
UKAEA	3.924E-02	1.303E-04	1.431E-04	2.372E-04	3.209E-04	4.060E-04	5.451E-04	6.071E-04
MEAN	4.498E-02	1.814E-04	1.971E-04	2.648E-04	3.418E-04	2.892E-04	4.950E-04	6.514E-04
ST. DEV.	2.268E-02	2.373E-05	2.183E-05	1.182E-05	8.561E-06	5.067E-05	4.993E-05	8.988E-05

TABLE 18 - Na in Na tank σ_{α}

DATA SET	GROUP 9	GROUP 10	GROUP 11	GROUP 12	GROUP 13	GROUP 14	GROUP 15
VITAM.-C	7.282E-04	2.006E-03	2.337E-04	7.811E-03	8.517E-03	1.458E-02	9.425E-02
VITAM.-E	4.008E-04	1.603E-03	2.820E-05	5.897E-03	6.270E-03	1.424E-02	9.698E-02
RADHEAT	6.518E-04	1.476E-03	2.328E-04	9.151E-03	8.500E-03	1.451E-02	1.021E-01
BABEL	8.460E-04	2.677E-03	2.336E-04	7.088E-03	8.475E-03	1.455E-02	9.989E-02
PROP.-D0	7.588E-04	2.102E-03	2.356E-04	8.114E-03	8.095E-03	1.563E-02	1.139E-01
PROP.-D1	7.489E-04	2.098E-03	2.347E-04	8.043E-03	8.064E-03	1.541E-02	1.135E-01
EURLIB	8.323E-04	3.585E-03	2.334E-04	9.256E-03	8.527E-03	1.443E-02	5.904E-02
UKAEA	1.063E-03	1.637E-03	2.355E-03	1.502E-02	6.107E-03	1.427E-02	5.935E-02
MEAN	7.537E-04	2.148E-03	4.733E-04	8.797E-03	7.819E-03	1.470E-02	9.237E-02
ST. DEV.	1.874E-04	6.948E-04	7.636E-04	2.735E-03	1.025E-03	5.223E-04	2.167E-02

TABLE 18 (contd.) Na in Na tank σ_a

DATA SET	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
VITAM.-C	1.676E+00	2.280E+00	2.590E+00	4.760E+00	4.841E+00	2.978E+00	3.359E+00	2.710E+00
VITAM.-E	1.747E+00	2.361E+00	2.650E+00	4.882E+00	4.978E+00	3.017E+00	3.474E+00	2.518E+00
RADHEAT	1.743E+00	2.382E+00	2.595E+00	5.016E+00	4.318E+00	2.931E+00	3.383E+00	2.731E+00
BABEL	1.695E+00	2.386E+00	2.588E+00	4.999E+00	4.303E+00	2.929E+00	3.393E+00	2.747E+00
PROP.-D0	1.814E+00	2.544E+00	2.579E+00	4.748E+00	4.309E+00	2.926E+00	3.403E+00	2.602E+00
PROP.-D1	1.816E+00	2.532E+00	2.569E+00	4.728E+00	4.284E+00	2.909E+00	3.379E+00	2.584E+00
EURLIB	1.682E+00	2.399E+00	2.634E+00	5.137E+00	4.351E+00	3.052E+00	3.398E+00	3.056E+00
UKAEA	1.714E+00	2.410E+00	2.671E+00	5.152E+00	4.522E+00	3.108E+00	3.398E+00	3.011E+00
MEAN	1.736E+00	2.412E+00	2.610E+00	4.928E+00	4.488E+00	2.981E+00	3.398E+00	2.745E+00
ST. DEV.	5.532E-02	8.733E-02	3.738E-02	1.731E-01	2.731E-01	7.166E-02	3.380E-02	1.953E-01

TABLE 19 - Na in Na tank σ_S

DATA SET	GROUP 9	GROUP 10	GROUP 11	GROUP 12	GROUP 13	GROUP 14	GROUP 15
VITAM.-C	3.592E+00	4.148E+00	4.062E+00	9.356E+00	3.475E+00	3.139E+00	3.193E+00
VITAM.-E	3.612E+00	4.339E+00	4.244E+00	9.095E+00	3.479E+00	3.141E+00	3.200E+00
RADHEAT	3.593E+00	4.111E+00	4.043E+00	9.846E+00	3.469E+00	3.140E+00	3.200E+00
BABEL	3.587E+00	4.159E+00	4.064E+00	9.391E+00	3.459E+00	3.140E+00	3.241E+00
PROP.-D0	3.573E+00	4.040E+00	4.111E+00	8.492E+00	3.341E+00	3.141E+00	3.263E+00
PROP.-D1	3.493E+00	3.864E+00	3.916E+00	8.105E+00	3.177E+00	3.036E+00	3.261E+00
EURLIB	3.597E+00	4.569E+00	4.053E+00	1.025E+01	3.480E+00	3.140E+00	3.168E+00
UKAEA	3.553E+00	4.413E+00	4.212E+00	8.531E+00	3.300E+00	3.108E+00	3.171E+00
MEAN	3.575E+00	4.205E+00	4.088E+00	9.133E+00	3.397E+00	3.123E+00	3.212E+00
ST. DEV.	3.770E-02	2.241E-01	1.031E-01	7.270E-01	1.132E-01	3.691E-02	3.822E-02

TABLE 19 (contd.) - Na in tank σ_S

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 167		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-6.310E-05	1.312E-04	6.809E-05	-1.991E-05	3.394E-05	1.403E-05	-2.110E-05	3.644E-05	1.534E-05
2	-2.717E-04	6.616E-03	6.344E-03	-8.628E-05	1.686E-03	1.600E-03	-9.141E-05	1.812E-03	1.720E-03
3	-2.433E-04	8.664E-03	8.421E-03	-6.856E-05	1.758E-03	1.689E-03	-7.309E-05	1.917E-03	1.844E-03
4	-3.407E-03	1.198E-01	1.164E-01	-8.847E-04	2.258E-02	2.170E-02	-9.459E-04	2.471E-02	2.377E-02
5	-2.358E-03	1.461E-01	1.438E-01	-8.146E-04	3.245E-02	3.164E-02	-8.607E-04	3.527E-02	3.441E-02
6	7.276E-04	1.389E-01	1.397E-01	3.056E-04	3.399E-02	3.430E-02	3.203E-04	3.683E-02	3.715E-02
7	4.223E-03	1.566E-01	1.608E-01	2.176E-03	4.143E-02	4.360E-02	2.273E-03	4.480E-02	4.707E-02
8	1.823E-04	2.192E-02	2.210E-02	4.810E-04	1.517E-02	1.565E-02	4.898E-04	1.598E-02	1.647E-02
9	0.0	0.0	0.0	7.884E-03	7.800E-02	8.588E-02	8.243E-03	8.486E-02	9.811E-02
10	0.0	0.0	0.0	4.023E-03	2.528E-03	6.551E-03	3.642E-03	2.456E-03	6.098E - 03
11	0.0	0.0	0.0	-7.948E-04	9.116E-03	8.321E-03	-6.910E-04	8.438E-03	7.747E-03
12	0.0	0.0	0.0	5.695E-03	-2.866E-03	2.830E-03	4.673E-03	-2.343E-03	2.330E-03
13	0.0	0.0	0.0	6.143E-02	3.661E-03	6.509E-02	5.130E-02	3.711E-03	5.501E-02
14	0.0	0.0	0.0	5.890E-03	9.722E-04	6.863E-03	4.085E-03	6.727E-04	4.757E - 03
15	0.0	0.0	0.0	-1.491E-03	-4.268E-05	-1.534E-03	-1.849E-03	7.466E-05	-1.775E - 03
SUM	-1.211E-03	5.988E-01	5.976E-01	8.373E-02	2.405E-01	3.242E-01	7.049E-02	2.592E-01	3.297E - 01

TABLE 20 VI[illegible] - BABEL / BABEL Fe Effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-4.544E-04	1.895E-04	-2.649E-04	-1.434E-04	4.934E-05	-9.405E-05	-1.520E-04	5.293E-05	-9.903E-05
2	-2.335E-04	-6.726E-04	-9.061E-04	-7.414E-05	-1.705E-04	-2.446E-04	-7.854E-05	-1.832E-04	-2.618E-04
3	-2.810E-05	-1.913E-03	-1.941E-03	-7.918E-06	-4.111E-04	-4.190E-04	-8.440E-06	-4.468E-04	-4.552E-04
4	-1.491E-02	-8.474E-03	-2.339E-02	-3.873E-03	-1.585E-03	-5.458E-03	-4.141E-03	-1.733E-03	-5.674E-03
5	-3.018E-03	7.022E-02	6.720E-02	-1.043E-03	1.547E-02	1.443E-02	-1.102E-03	1.683E-02	1.573E-02
6	-3.954E-05	1.023E-03	9.838E-04	-1.660E-05	2.502E-04	2.336E-04	-1.741E-05	2.711E-04	2.537E-04
7	2.296E-04	5.527E-02	5.550E-02	1.183E-04	1.425E-02	1.437E-02	1.236E-04	1.544E-02	1.556E-02
8	3.943E-06	1.142E-03	1.146E-03	1.040E-05	8.026E-04	8.130E-04	1.059E-05	8.455E-04	8.561E-04
9	0.0	0.0	0.0	5.992E-04	1.170E-02	1.230E-02	6.265E-04	1.274E-02	1.337E-02
10	0.0	0.0	0.0	6.991E-05	-8.603E-03	-8.533E-03	6.329E-05	-8.268E-03	-8.204E-03
11	0.0	0.0	0.0	1.161E-03	-2.784E-04	8.823E-04	1.009E-03	-2.590E-04	7.502E-04
12	0.0	0.0	0.0	8.052E-03	8.132E-04	8.865E-03	6.606E-03	6.712E-04	7.278E-03
13	0.0	0.0	0.0	-1.285E-04	-7.861E-05	-2.071E-04	-1.073E-04	-7.915E-05	-1.865E-04
14	0.0	0.0	0.0	-1.912E-04	-8.171E-05	-2.729E-04	-1.326E-04	-5.686E-05	-1.894E-04
15	0.0	0.0	0.0	-1.204E-03	-1.887E-05	-1.222E-03	-1.490E-03	3.311E-05	-1.457E-03
SUM	-1.845E-02	1.168E-01	9.833E-02	3.330E-03	3.211E-02	3.544E-02	1.211E-03	3.585E-02	3.706E-02

TABLE 21 - $\frac{\text{VIT.E - BABEL}}{\text{BABEL}}$ Cr effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	4.175E-05	-1.494E-04	-1.077E-04	1.318E-05	-3.926E-05	-2.608E-05	1.396E-05	-4.210E-05	-2.614E-05
2	-5.102E-04	-1.076E-03	-1.586E-03	-1.620E-04	-2.717E-04	-4.337E-04	-1.716E-04	-2.923E-04	-4.639E-04
3	1.220E-04	-5.134E-03	-5.012E-03	3.438E-05	-1.115E-03	-1.080E-03	3.665E-05	-1.211E-03	-1.174E-03
4	-1.137E-05	-1.151E-02	-1.152E-02	-2.953E-06	-2.089E-03	-2.092E-03	-3.157E-06	-2.288E-03	-2.291E-03
5	-4.977E-05	-4.349E-03	-4.399E-03	-1.719E-05	-9.746E-04	-9.918E-04	-1.816E-05	-1.059E-03	-1.077E-03
6	2.014E-05	1.189E-02	1.191E-02	8.458E-06	2.993E-03	3.001E-03	8.866E-06	3.234E-03	3.243E-03
7	-1.210E-05	8.416E-03	8.404E-03	-6.234E-06	2.156E-03	2.150E-03	-6.510E-06	2.336E-03	2.329E-03
8	-3.757E-06	6.921E-04	6.883E-04	-9.913E-06	4.807E-04	4.708E-04	-1.009E-05	5.064E-04	4.964E-04
9	0.0	0.0	0.0	6.022E-04	-5.566E-03	-4.964E-03	6.296E-04	-6.086E-03	-5.456E-03
10	0.0	0.0	0.0	5.907E-04	3.863E-03	4.453E-03	5.347E-04	3.734E-03	4.269E-03
11	0.0	0.0	0.0	7.310E-04	3.322E-02	3.395E-02	6.356E-04	3.125E-02	3.188E-02
12	0.0	0.0	0.0	8.795E-04	1.240E-03	2.120E-03	7.215E-04	1.020E-03	1.742E-03
13	0.0	0.0	0.0	-7.451E-05	-1.873E-04	-2.618E-04	-6.222E-05	-1.886E-04	-2.508E-04
14	0.0	0.0	0.0	-1.257E-04	-7.815E-05	-2.038E-04	-8.715E-05	-5.385E-05	-1.410E-04
15	0.0	0.0	0.0	-7.082E-04	-2.305E-05	-7.313E-04	-8.797E-04	4.067E-05	-8.391E-04
SUM	-4.033E-04	-1.214E-03	-1.617E-03	1.753E-03	3.361E-02	3.536E-02	1.342E-03	3.090E-02	3.224E-02

TABLE 22 - VIT.E BABEL / BABEL Ni effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-6.933E-06	-7.546E-04	-7.615E-04	-2.186E-06	-1.951E-04	-1.973E-04	-2.317E-06	-2.094E-04	-2.117E-04
2	-4.978E-07	-8.850E-05	-8.899E-05	-1.580E-07	-2.261E-05	-2.277E-05	-1.674E-07	-2.429E-05	-2.445E-05
3	2.154E-07	-8.732E-03	-8.732E-03	6.080E-08	-1.811E-03	-1.811E-03	6.480E-08	-1.971E-03	-1.971E-03
4	1.133E-05	6.350E-02	6.351E-02	2.918E-06	1.063E-02	1.064E-02	3.122E-06	1.175E-02	1.175E-02
5	-7.994E-07	-2.115E-01	-2.115E-01	-2.630E-07	-4.607E-02	-4.607E-02	-2.784E-07	-5.026E-02	-5.026E-02
6	-5.307E-05	-3.816E-02	-3.822E-02	-2.046E-05	-9.180E-03	-9.200E-03	-2.158E-05	-1.002E-02	-1.004E-02
7	7.828E-05	-3.439E-02	-3.431E-02	2.988E-05	-8.757E-03	-8.728E-03	3.198E-05	-9.596E-03	-9.564E-03
8	7.025E-06	1.221E-02	1.222E-02	-1.776E-05	3.337E-03	3.319E-03	-1.672E-05	3.802E-03	3.785E-03
9	0.0	0.0	0.0	1.158E-03	-9.678E-03	-8.520E-03	1.401E-03	-1.188E-02	-1.048E-02
10	0.0	0.0	0.0	6.340E-04	-6.175E-03	-5.541E-03	1.096E-03	-1.168E-02	-1.058E-02
11	0.0	0.0	0.0	1.921E-04	-5.007E-03	-4.815E-03	2.950E-04	-1.269E-02	-1.240E-02
12	0.0	0.0	0.0	2.118E-03	3.491E-03	5.610E-03	2.914E-03	5.668E-03	8.582E-03
13	0.0	0.0	0.0	4.462E-03	6.141E-05	4.523E-03	1.906E-02	-7.666E-03	1.139E-02
14	0.0	0.0	0.0	9.334E-04	-4.188E-05	8.915E-04	8.411E-03	-1.940E-03	6.471E-03
15	0.0	0.0	0.0	2.580E-03	-4.648E-04	2.115E-03	6.333E-02	2.271E-02	8.605E-02
SUM	3.555E-05	-2.179E-01	-2.178E-01	1.207E-02	-6.988E-02	-5.781E-02	9.651E-02	-7.402E-02	2.249E-02

TABLE 23 - $\frac{\text{VIT.E - BABEL}}{\text{BABEL}}$ Na effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-4.827E-04	-5.833E-04	-1.066E-03	-1.523E-04	-1.511E-04	-3.034E-04	-1.614E-04	-1.621E-04	-3.235E-04
2	-1.016E-03	4.779E-03	3.763E-03	-3.226E-04	1.221E-03	8.986E-04	-3.418E-04	1.312E-03	9.702E-04
3	-1.492E-04	-7.115E-03	-7.264E-03	-4.204E-05	-1.579E-03	-1.621E-03	-4.482E-05	-1.711E-03	-1.756E-03
4	-1.832E-02	1.634E-01	1.450E-01	-4.758E-03	2.955E-02	2.479E-02	-5.087E-03	3.244E-02	2.735E-02
5	-5.427E-03	5.455E-04	-4.882E-03	-1.875E-03	8.719E-04	-1.003E-03	-1.981E-03	7.794E-04	-1.201E-03
6	6.551E-04	1.137E-01	1.144E-01	2.770E-04	2.806E-02	2.833E-02	2.902E-04	3.031E-02	3.061E-02
7	4.518E-03	1.859E-01	1.904E-01	2.318E-03	4.908E-02	5.140E-02	2.422E-03	5.297E-02	5.540E-02
8	1.895E-04	3.597E-02	3.616E-02	4.637E-04	1.979E-02	2.025E-02	4.736E-04	2.113E-02	2.161E-02
9	0.0	0.0	0.0	1.024E-02	7.446E-02	8.470E-02	1.090E-02	7.963E-02	9.053E-02
10	0.0	0.0	0.0	5.318E-03	-8.388E-03	-3.070E-03	5.336E-03	-1.376E-02	-8.419E-03
11	0.0	0.0	0.0	1.289E-03	3.705E-02	3.834E-02	1.249E-03	2.673E-02	2.796E-02
12	0.0	0.0	0.0	1.675E-02	2.679E-03	1.942E-02	1.492E-02	5.016E-03	1.993E-02
13	0.0	0.0	0.0	6.569E-02	3.456E-03	6.915E-02	7.019E-02	-4.223E-03	6.597E-02
14	0.0	0.0	0.0	6.507E-03	7.705E-04	7.277E-03	1.228E-02	-1.378E-03	1.090E-02
15	0.0	0.0	0.0	-8.230E-04	-5.494E-04	-1.372E-03	5.911E-02	2.286E-02	8.198E-02
SUM	-2.003E-02	4.965E-01	4.765E-01	1.009E-01	2.363E-01	3.372E-01	1.695E-01	2.520E-01	4.215E-01

TABLE 24 - $\frac{\text{VIT.E - BABEL}}{\text{BABEL}}$ Total effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	2.849E-03	-1.297E-03	1.552E-03	8.991E-04	-3.356E-04	5.634E-04	9.527E-04	-3.603E-04	5.924E-04
2	2.399E-03	9.306E-04	3.330E-03	7.619E-04	2.371E-04	9.990E-04	8.072E-04	2.548E-04	1.062E-03
3	8.672E-04	2.525E-02	2.612E-02	2.443E-04	5.123E-03	5.367E-03	2.605E-04	5.588E-03	5.848E-03
4	1.741E-06	1.597E-01	1.597E-01	4.520E-07	3.010E-02	3.010E-02	4.833E-07	3.294E-02	3.294E-02
5	3.161E-06	9.497E-02	9.498E-02	1.092E-06	2.109E-02	2.109E-02	1.154E-06	2.292E-02	2.293E-02
6	-1.102E-05	1.099E-01	1.099E-01	-4.629E-06	2.688E-02	2.688E-02	-4.853E-06	2.912E-02	2.912E-02
7	-1.837E-05	1.480E-01	1.480E-01	-9.465E-06	3.915E-02	3.914E-02	-9.884E-06	4.234E-02	4.233E-02
8	-5.162E-07	1.309E-02	1.309E-02	-1.362E-06	9.056E-03	9.055E-03	-1.387E-06	9.542E-03	9.541E-03
9	0.0	0.0	0.0	-1.309E-03	4.694E-03	3.386E-03	-1.368E-03	5.108E-03	3.739E-03
10	0.0	0.0	0.0	8.010E-03	-5.679E-03	2.332E-03	7.252E-03	-5.519E-03	1.733E-03
11	0.0	0.0	0.0	-1.106E-03	-1.329E-01	-1.340E-01	-9.616E-04	-1.230E-01	-1.240E-01
12	0.0	0.0	0.0	1.721E-03	-3.682E-03	-1.961E-03	1.412E-03	-3.011E-03	-1.599E-03
13	0.0	0.0	0.0	6.068E-02	3.577E-05	6.072E-02	5.067E-02	3.627E-05	5.071E-02
14	0.0	0.0	0.0	1.469E-04	2.276E-05	1.697E-04	1.019E-04	1.575E-05	1.176E-04
15	0.0	0.0	0.0	-1.504E-03	-4.266E-06	-1.508E-03	-1.865E-03	7.463E-06	-1.857E-03
SUM	6.091E-03	5.505E-01	5.566E-01	6.853E-02	-6.243E-03	6.229E-02	5.725E-02	1.594E-02	7.319E-02

TABLE 25 – $\frac{\text{RADHEAT-BABEL}}{\text{BABEL}}$ Fe effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	2.499E-04	-1.099E-04	1.400E-04	7.887E-05	-2.861E-05	5.026E-05	8.358E-05	-3.069E-05	5.289E-05
2	1.050E-04	9.573E-05	2.007E-04	3.334E-05	2.426E-05	5.760E-05	3.532E-05	2.608E-05	6.140E-05
3	8.107E-06	-1.257E-03	-1.249E-03	2.284E-06	-2.701E-04	-2.678E-04	2.435E-06	-2.935E-04	-2.911E-04
4	5.428E-06	5.727E-03	5.732E-03	1.410E-06	1.071E-03	1.072E-03	1.507E-06	1.171E-03	1.173E-03
5	4.906E-05	8.589E-03	8.638E-03	1.694E-05	1.892E-03	1.909E-03	1.790E-05	2.058E-03	2.076E-03
6	1.318E-05	6.945E-03	6.958E-03	5.535E-06	1.698E-03	1.704E-03	5.802E-06	1.840E-03	1.846E-03
7	2.092E-04	6.004E-02	6.025E-02	1.078E-04	1.548E-02	1.559E-02	1.126E-04	1.677E-02	1.688E-02
8	1.017E-06	9.463E-04	9.474E-04	2.684E-06	6.649E-04	6.675E-04	2.733E-06	7.004E-04	7.031E-04
9	0.0	0.0	0.0	5.145E-04	1.683E-02	1.735E-02	5.379E-04	1.833E-02	1.886E-02
10	0.0	0.0	0.0	4.082E-04	-7.297E-03	-6.889E-03	3.695E-04	-7.013E-03	-6.644E-03
11	0.0	0.0	0.0	1.711E-03	-6.499E-03	-4.788E-03	1.487E-03	-6.045E-03	-4.558E-03
12	0.0	0.0	0.0	1.576E-02	2.728E-03	1.849E-02	1.293E-02	2.251E-03	1.518E-02
13	0.0	0.0	0.0	-6.318E-05	-2.023E-05	-8.341E-05	-5.276E-05	-2.037E-05	-7.312E-05
14	0.0	0.0	0.0	5.112E-05	-2.041E-06	4.908E-05	3.545E-05	-1.420E-06	3.403E-05
15	0.0	0.0	0.0	-1.321E-03	-2.973E-06	-1.324E-03	-1.635E-03	5.217E-06	-1.630E-03
SUM	6.409E-04	8.098E-02	8.162E-02	1.731E-02	2.628E-02	4.359E-02	1.394E-02	2.974E-02	4.368E-02

TABLE 26 – $\frac{\text{RADHEAT-BABEL}}{\text{BABEL}}$ Cr effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	3.717E-03	-1.691E-03	2.026E-03	1.173E-03	-4.443E-04	7.286E-04	1.243E-03	-4.765E-04	7.664E-04
2	5.214E-03	-2.226E-03	2.988E-03	1.656E-03	-5.622E-04	1.093E-03	1.754E-03	-6.049E-04	1.149E-03
3	3.152E-03	-1.136E-03	2.016E-03	8.882E-04	-2.467E-04	6.415E-04	9.468E-04	-2.679E-04	6.789E-04
4	4.351E-04	-3.759E-04	5.926E-05	1.130E-04	-6.823E-05	4.477E-05	1.208E-04	-7.475E-05	4.607E-05
5	1.469E-05	4.825E-03	4.839E-03	5.073E-06	1.081E-03	1.086E-03	5.360E-06	1.174E-03	1.180E-03
6	7.537E-06	5.885E-03	5.892E-03	3.166E-06	1.481E-03	1.484E-03	3.318E-06	1.600E-03	1.604E-03
7	-1.230E-05	1.437E-02	1.436E-02	-6.341E-06	3.683E-03	3.676E-03	-6.621E-06	3.990E-03	3.983E-03
8	-6.203E-06	-6.859E-05	-7.479E-05	-1.637E-05	-4.764E-05	-6.401E-05	-1.667E-05	-5.020E-05	-6.686E-05
9	0.0	0.0	0.0	3.627E-04	-6.395E-03	-6.032E-03	3.793E-04	-6.992E-03	-6.612E-03
10	0.0	0.0	0.0	8.343E-04	8.669E-03	9.503E-03	7.553E-04	8.380E-03	9.135E-03
11	0.0	0.0	0.0	1.714E-03	7.642E-02	7.813E-02	1.491E-03	7.189E-02	7.338E-02
12	0.0	0.0	0.0	1.085E-03	2.468E-03	3.552E-03	8.898E-04	2.030E-03	2.920E-03
13	0.0	0.0	0.0	-4.202E-05	6.725E-06	-3.530E-05	-3.509E-05	6.771E-06	-2.832E-05
14	0.0	0.0	0.0	3.427E-05	2.137E-06	3.641E-05	2.377E-05	1.473E-06	2.524E-05
15	0.0	0.0	0.0	-7.745E-04	-3.929E-06	-7.784E-04	-9.620E-04	6.931E-06	-9.551E-04
SUM	1.252E-02	1.959E-02	3.211E-02	7.029E-03	8.604E-02	9.307E-02	6.591E-03	8.061E-02	8.720E-02

TABLE 27 - $\frac{\text{RADHEAT-BABEL}}{\text{BABEL}}$ Ni effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	5.511E-04	-2.464E-04	3.046E-04	1.739E-04	-6.372E-05	1.102E-04	1.843E-04	-6.838E-05	1.159E-04
2	3.613E-06	3.066E-05	3.427E-05	1.147E-06	7.840E-06	8.987E-06	1.215E-06	8.423E-06	9.638E-06
3	-4.191E-08	-1.241E-04	-1.241E-04	-1.177E-08	-2.590E-05	-2.592E-05	-1.255E-08	-2.823E-05	-2.824E-05
4	-3.673E-07	-2.113E-03	-2.113E-03	-9.456E-08	-3.565E-04	-3.566E-04	-1.012E-07	-3.943E-04	-3.944E-04
5	1.218E-07	2.335E-04	2.336E-04	4.228E-08	4.655E-05	4.660E-05	4.467E-08	5.019E-05	5.024E-05
6	-1.420E-06	6.701E-03	6.699E-03	-5.602E-07	1.584E-03	1.584E-03	-5.898E-07	1.721E-03	1.720E-03
7	5.422E-07	-7.512E-03	-7.511E-03	1.499E-06	-1.896E-03	-1.895E-03	1.475E-06	-2.044E-03	-2.043E-03
8	1.300E-09	3.940E-03	3.940E-03	2.794E-08	2.180E-03	2.180E-03	2.753E-08	2.320E-03	2.320E-03
9	0.0	0.0	0.0	4.780E-04	-4.040E-03	-3.562E-03	5.827E-04	-4.728E-03	-4.145E-03
10	0.0	0.0	0.0	3.003E-04	-4.219E-03	-3.919E-03	8.555E-04	-2.602E-03	-1.747E-03
11	0.0	0.0	0.0	9.354E-07	1.493E-03	1.494E-03	1.337E-06	2.329E-03	2.330E-03
12	0.0	0.0	0.0	-2.753E-03	-7.406E-03	-1.016E-02	-4.297E-03	-1.039E-02	-1.468E-02
13	0.0	0.0	0.0	-3.178E-05	1.324E-04	1.006E-04	-2.003E-04	-3.706E-03	-3.906E-03
14	0.0	0.0	0.0	7.959E-05	-3.213E-06	7.638E-05	1.050E-03	-2.693E-04	7.809E-04
15	0.0	0.0	0.0	-2.163E-03	-4.398E-04	-2.603E-03	-4.927E-02	2.208E-02	-2.719E-02
SUM	5.535E-04	9.095E-04	1.463E-03	-3.913E-03	-1.301E-02	-1.692E-02	-5.109E-02	4.281E-03	-4.681E-02

TABLE 28 - $\frac{\text{RADHEAT-BABEL}}{\text{BABEL}}$ Na effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	7.367E-03	-3.345E-03	4.022E-03	2.325E-03	-8.723E-04	1.452E-03	2.463E-03	-9.358E-04	1.528E-03
2	7.722E-03	-1.169E-03	6.553E-03	2.452E-03	-2.930E-04	2.159E-03	2.598E-03	-3.155E-04	2.282E-03
3	4.028E-03	2.273E-02	2.676E-02	1.135E-03	4.580E-03	5.715E-03	1.210E-03	4.998E-03	6.208E-03
4	4.419E-04	1.630E-01	1.634E-01	1.148E-04	3.075E-02	3.086E-02	1.227E-04	3.364E-02	3.376E-02
5	6.702E-05	1.086E-01	1.087E-01	2.315E-05	2.411E-02	2.413E-02	2.446E-05	2.621E-02	2.623E-02
6	8.274E-06	1.294E-01	1.294E-01	3.511E-06	3.164E-02	3.165E-02	3.678E-06	3.428E-02	3.429E-02
7	1.791E-04	2.149E-01	2.151E-01	9.351E-05	5.642E-02	5.652E-02	9.756E-05	6.105E-02	6.115E-02
8	-5.700E-06	1.791E-02	1.790E-02	-1.502E-05	1.185E-02	1.184E-02	-1.529E-05	1.251E-02	1.250E-02
9	0.0	0.0	0.0	4.645E-05	1.109E-02	1.114E-02	1.315E-04	1.171E-02	1.184E-02
10	0.0	0.0	0.0	9.553E-03	-8.526E-03	1.027E-03	9.232E-03	-6.754E-03	2.478E-03
11	0.0	0.0	0.0	2.320E-03	-6.152E-02	-5.920E-02	2.017E-03	-5.487E-02	-5.286E-02
12	0.0	0.0	0.0	1.582E-02	-5.893E-03	9.923E-03	1.094E-02	-9.114E-03	1.823E-03
13	0.0	0.0	0.0	6.055E-02	1.547E-04	6.070E-02	5.038E-02	-3.683E-03	4.670E-02
14	0.0	0.0	0.0	3.119E-04	1.964E-05	3.315E-04	1.211E-03	-2.535E-04	9.578E-04
15	0.0	0.0	0.0	-5.762E-03	-4.510E-04	-6.213E-03	-5.373E-02	2.210E-02	-3.164E-02
SUM	1.981E-02	6.520E-01	6.718E-01	8.896E-02	9.307E-02	1.820E-01	2.668E-02	1.306E-01	1.573E-01

TABLE 29 - $\frac{\text{RADHEAT-BABEL}}{\text{BABEL}}$ Total effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-5.205E-05	1.165E-04	6.445E-05	-1.643E-05	3.014E-05	1.372E-05	-1.741E-05	3.236E-05	1.495E-05
2	-2.285E-04	6.619E-03	6.390E-03	-7.257E-05	1.687E-03	1.614E-03	-7.688E-05	1.813E-03	1.736E-03
3	-1.375E-04	1.078E-02	1.064E-02	-3.874E-05	2.187E-03	2.148E-03	-4.130E-05	2.385E-03	2.344E-03
4	5.658E-04	1.286E-01	1.291E-01	1.469E-04	2.423E-02	2.437E-02	1.571E-04	2.651E-02	2.667E-02
5	-2.388E-05	1.466E-01	1.465E-01	-8.247E-06	3.255E-02	3.254E-02	-8.714E-06	3.538E-02	3.537E-02
6	-6.199E-05	1.431E-01	1.430E-01	-2.603E-05	3.500E-02	3.498E-02	-2.729E-05	3.793E-02	3.790E-02
7	-1.774E-05	1.640E-01	1.640E-01	-9.143E-06	4.340E-02	4.339E-02	-9.547E-06	4.693E-02	4.692E-02
8	-7.353E-07	7.565E-03	7.565E-03	-1.940E-06	5.234E-03	5.232E-03	-1.976E-06	5.515E-03	5.513E-03
9	0.0	0.0	0.0	1.061E-04	2.516E-02	2.527E-02	1.109E-04	2.737E-02	2.748E-02
10	0.0	0.0	0.0	2.713E-03	1.820E-03	4.533E-03	2.456E-03	1.769E-03	4.225E-03
11	0.0	0.0	0.0	9.243E-04	1.124E-02	1.217E-02	8.036E-04	1.041E-02	1.121E-02
12	0.0	0.0	0.0	3.554E-04	-3.892E-03	-3.537E-03	2.916E-04	-3.182E-03	-2.891E-03
13	0.0	0.0	0.0	3.964E-02	-1.173E-04	3.953E-02	3.310E-02	-1.189E-04	3.299E-02
14	0.0	0.0	0.0	-6.999E-04	4.049E-05	-6.595E-04	-4.854E-04	2.801E-05	-4.574E-04
15	0.0	0.0	0.0	-1.265E-03	0.0	-1.265E-03	-1.569E-03	0.0	-1.569E-03
SUM	4.338E-05	6.073E-01	6.074E-01	4.175E-02	1.786E-01	2.203E-01	3.469E-02	1.928E-01	2.275E-01

TABLE 30 - $\frac{\text{VIT.C-BABEL}}{\text{BABEL}}$ Fe effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-3.871E-05	2.262E-05	-1.609E-05	-1.222E-05	5.889E-06	-6.326E-06	-1.294E-05	6.317E-06	-6.627E-06
2	-7.238E-06	-7.625E-04	-7.698E-04	-2.298E-06	-1.933E-04	-1.956E-04	-2.435E-06	-2.077E-04	-2.102E-04
3	2.303E-05	-1.433E-03	-1.409E-03	6.489E-06	-3.078E-04	-3.013E-04	6.918E-06	-3.345E-04	-3.276E-04
4	-9.563E-05	-8.368E-03	-8.464E-03	-2.484E-05	-1.565E-03	-1.590E-03	-2.655E-05	-1.711E-03	-1.738E-03
5	-1.337E-04	3.683E-02	3.670E-02	-4.618E-05	8.114E-03	8.068E-03	-4.879E-05	8.826E-03	8.778E-03
6	-4.790E-05	1.595E-03	1.547E-03	-2.012E-05	3.899E-04	3.698E-04	-2.109E-05	4.224E-04	4.013E-04
7	2.227E-04	5.491E-02	5.513E-02	1.148E-04	1.416E-02	1.428E-02	1.199E-04	1.534E-02	1.546E-02
8	2.892E-06	1.075E-03	1.078E-03	7.631E-06	7.555E-04	7.631E-04	7.771E-06	7.958E-04	8.036E-04
9	0.0	0.0	0.0	2.420E-04	9.509E-03	9.751E-03	2.530E-04	1.035E-02	1.060E-02
10	0.0	0.0	0.0	2.958E-05	-7.647E-03	-7.618E-03	2.678E-05	-7.350E-03	-7.323E-03
11	0.0	0.0	0.0	1.157E-03	-3.181E-04	8.388E-04	1.006E-03	-2.959E-04	7.100E-04
12	0.0	0.0	0.0	6.925E-03	7.241E-04	7.649E-03	5.682E-03	5.977E-04	6.279E-03
13	0.0	0.0	0.0	-1.960E-04	-3.910E-04	-5.870E-04	-1.637E-04	-3.937E-04	-5.573E-04
14	0.0	0.0	0.0	-9.597E-05	-1.412E-04	-2.371E-04	-6.654E-05	-9.823E-05	-1.648E-04
15	0.0	0.0	0.0	-9.927E-04	-9.035E-06	-1.002E-03	-1.229E-03	1.585E-05	-1.213E-03
SUM	-7.450E-05	8.387E-02	8.380E-02	7.092E-03	2.309E-02	3.018E-02	5.531E-03	2.596E-02	3.149E-02

TABLE 31 - $\frac{\text{VIT.C-BABEL}}{\text{BABEL}}$ Cr effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-8.422E-06	9.242E-06	8.199E-07	-2.658E-06	2.428E-06	-2.296E-07	-2.816E-06	2.604E-06	-2.125E-07
2	-4.302E-04	-2.911E-04	-7.213E-04	-1.366E-04	-7.352E-05	-2.101E-04	-1.447E-04	-7.910E-05	-2.238E-04
3	-3.335E-04	1.529E-05	-3.182E-04	-9.397E-05	3.319E-06	-9.065E-05	-1.002E-04	3.604E-06	-9.656E-05
4	-5.206E-05	4.620E-03	4.568E-03	-1.352E-05	8.387E-04	8.252E-04	-1.445E-05	9.188E-04	9.043E-04
5	1.148E-06	-3.426E-03	-3.425E-03	3.964E-07	-7.677E-04	-7.673E-04	4.188E-07	-8.338E-04	-8.334E-04
6	1.435E-05	1.169E-02	1.170E-02	6.026E-06	2.940E-03	2.946E-03	6.317E-06	3.178E-03	3.184E-03
7	-2.201E-05	9.007E-03	8.985E-03	-1.134E-05	2.308E-03	2.296E-03	-1.185E-05	2.500E-03	2.488E-03
8	-5.402E-06	3.225E-04	3.171E-04	-1.426E-05	2.240E-04	2.098E-04	-1.452E-05	2.360E-04	2.215E-04
9	0.0	0.0	0.0	4.222E-04	-9.014E-03	-8.592E-03	4.415E-04	-9.856E-03	-9.414E-03
10	0.0	0.0	0.0	5.481E-04	3.653E-03	4.202E-03	4.962E-04	3.532E-03	4.028E-03
11	0.0	0.0	0.0	6.756E-04	3.230E-02	3.298E-02	5.874E-04	3.039E-02	3.098E-02
12	0.0	0.0	0.0	7.385E-04	1.282E-03	2.021E-03	6.059E-04	1.055E-03	1.661E-03
13	0.0	0.0	0.0	-7.346E-05	-4.893E-04	-5.627E-04	-6.134E-05	-4.926E-04	-5.540E-04
14	0.0	0.0	0.0	-2.323E-04	-1.300E-04	-3.623E-04	-1.611E-04	-8.962E-05	-2.507E-04
15	0.0	0.0	0.0	-5.963E-04	-1.681E-06	-5.980E-04	-7.407E-04	2.966E-06	-7.378E-04
SUM	-8.361E-04	2.194E-02	2.111E-02	1.216E-03	3.308E-02	3.429E-02	8.859E-04	3.047E-02	3.135E-02

TABLE 32 - $\frac{\text{VIT.C-BABEL}}{\text{BABEL}}$ Ni effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-5.824E-06	1.321E-05	7.387E-06	-1.837E-06	3.417E-06	1.580E-06	-1.947E-06	3.667E-06	1.720E-06
2	-5.220E-07	2.865E-03	2.864E-03	-1.657E-07	7.323E-04	7.322E-04	-1.756E-07	7.868E-04	7.866E-04
3	9.720E-08	-5.654E-04	-5.653E-04	2.746E-08	-1.172E-04	-1.172E-04	2.926E-08	-1.276E-04	-1.276E-04
4	1.003E-05	1.068E-01	1.069E-01	2.587E-06	1.790E-02	1.791E-02	2.767E-06	1.978E-02	1.978E-02
5	-1.361E-06	-1.705E-01	-1.705E-01	-4.501E-07	-3.714E-02	-3.714E-02	-4.765E-07	-4.052E-02	-4.052E-02
6	-1.011E-05	-2.168E-02	-2.169E-02	-4.092E-06	-5.215E-03	-5.219E-03	-4.301E-06	-5.693E-03	-5.697E-03
7	-9.270E-06	8.163E-03	8.154E-03	-2.736E-06	2.088E-03	2.085E-03	-3.008E-06	2.306E-03	2.303E-03
8	1.662E-08	1.564E-03	1.564E-03	1.793E-08	2.771E-04	2.771E-04	1.923E-08	3.381E-04	3.381E-04
9	0.0	0.0	0.0	1.263E-04	-6.460E-03	-6.334E-03	1.824E-04	-7.323E-03	-7.141E-03
10	0.0	0.0	0.0	1.143E-05	-3.550E-03	-3.539E-03	3.365E-04	-3.100E-03	-2.764E-03
11	0.0	0.0	0.0	-6.564E-08	1.175E-05	1.168E-05	-1.007E-07	9.109E-05	9.099E-05
12	0.0	0.0	0.0	-1.113E-03	-3.276E-03	-4.389E-03	-1.628E-03	-2.344E-03	-3.972E-03
13	0.0	0.0	0.0	-7.945E-05	-1.437E-05	-9.382E-05	-3.640E-04	-5.984E-03	-6.348E-03
14	0.0	0.0	0.0	-8.407E-05	2.486E-06	-8.158E-05	-6.669E-04	1.450E-03	7.832E-04
15	0.0	0.0	0.0	4.999E-03	-5.373E-04	4.462E-03	1.225E-01	2.640E-02	1.489E-01
SUM	-1.694E-05	-7.327E-02	-7.329E-02	3.854E-03	-3.529E-02	-3.144E-02	1.204E-01	-1.394E-02	1.064E-01

TABLE 33 - $\frac{\text{VIT.C-BABEL}}{\text{BABEL}}$ Na effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-1.050E-04	1.616E-04	5.657E-05	-3.314E-05	4.188E-05	8.741E-06	-3.511E-05	4.495E-05	9.831E-06
2	-6.665E-04	8.430E-03	7.764E-03	-2.116E-04	2.152E-03	1.941E-03	-2.242E-04	2.313E-03	2.088E-03
3	-4.479E-04	8.796E-03	8.348E-03	-1.262E-04	1.765E-03	1.639E-03	-1.345E-04	1.927E-03	1.792E-03
4	4.282E-04	2.317E-01	2.321E-01	1.112E-04	4.140E-02	4.151E-02	1.189E-04	4.550E-02	4.562E-02
5	-1.578E-04	9.503E-03	9.345E-03	-5.448E-05	2.752E-03	2.697E-03	-5.756E-05	2.852E-03	2.795E-03
6	-1.057E-04	1.347E-01	1.346E-01	-4.422E-05	3.312E-02	3.308E-02	-4.637E-05	3.583E-02	3.579E-02
7	1.737E-04	2.361E-01	2.363E-01	9.158E-05	6.196E-02	6.205E-02	9.548E-05	6.708E-02	6.717E-02
8	-3.229E-06	1.053E-02	1.052E-02	-8.547E-06	6.491E-03	6.482E-03	-8.702E-06	6.885E-03	6.876E-03
9	0.0	0.0	0.0	8.967E-04	1.919E-02	2.009E-02	9.878E-04	2.055E-02	2.153E-02
10	0.0	0.0	0.0	3.302E-03	-5.724E-03	-2.422E-03	3.316E-03	-5.149E-03	-1.834E-03
11	0.0	0.0	0.0	2.757E-03	4.324E-02	4.600E-02	2.397E-03	4.059E-02	4.299E-02
12	0.0	0.0	0.0	6.906E-03	-5.162E-03	1.744E-03	4.951E-03	-3.874E-03	1.077E-03
13	0.0	0.0	0.0	3.930E-02	-1.012E-03	3.828E-02	3.251E-02	-6.989E-03	2.553E-02
14	0.0	0.0	0.0	-1.112E-03	-2.282E-04	-1.340E-03	-1.380E-03	1.290E-03	-8.967E-05
15	0.0	0.0	0.0	2.145E-03	-5.480E-04	1.597E-03	1.190E-01	2.642E-02	1.454E-01
SUM	-8.842E-04	6.399E-01	6.390E-01	5.391E-02	1.994E-01	2.534E-01	1.615E-01	2.353E-01	3.967E-01

TABLE 34 – $\frac{\text{VIT.C-BABEL}}{\text{BABEL}}$ Total effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	2.295E-05	2.837E-04	3.066E-04	7.243E-06	7.340E-05	8.064E-05	7.676E-06	7.879E-05	8.647E-05
2	5.887E-06	1.651E-03	1.657E-03	1.869E-06	4.206E-04	4.225E-04	1.980E-06	4.520E-04	4.540E-04
3	4.640E-06	1.675E-03	1.680E-03	1.307E-06	3.398E-04	3.411E-04	1.394E-06	3.707E-04	3.721E-04
4	2.783E-05	5.071E-03	5.099E-03	7.227E-06	9.557E-04	9.630E-04	7.727E-06	1.046E-03	1.054E-03
5	3.178E-05	4.140E-03	4.172E-03	1.098E-05	9.194E-04	9.304E-04	1.160E-05	9.994E-04	1.011E-03
6	6.753E-05	6.998E-03	7.065E-03	2.836E-05	1.712E-03	1.740E-03	2.973E-05	1.855E-03	1.885E-03
7	1.039E-04	7.199E-03	7.303E-03	5.353E-05	1.905E-03	1.958E-03	5.590E-05	2.060E-03	2.116E-03
8	1.018E-05	6.879E-04	6.981E-04	2.687E-05	4.759E-04	5.028E-04	2.736E-05	5.015E-04	5.288E-04
9	0.0	0.0	0.0	3.567E-04	1.311E-03	1.668E-03	3.729E-04	1.426E-03	1.799E-03
10	0.0	0.0	0.0	1.828E-04	6.434E-03	6.616E-03	1.655E-04	6.252E-03	6.418E-03
11	0.0	0.0	0.0	6.464E-05	3.720E-03	3.785E-03	5.620E-05	3.444E-03	3.500E-03
12	0.0	0.0	0.0	7.962E-04	3.294E-03	4.090E-03	6.532E-04	2.693E-03	3.346E-03
13	0.0	0.0	0.0	2.042E-02	2.367E-03	2.278E-02	1.705E-02	2.400E-03	1.945E-02
14	0.0	0.0	0.0	8.029E-04	2.957E-04	1.099E-03	5.568E-04	2.046E-04	7.614E-04
15	0.0	0.0	0.0	0.0	-4.271E-06	-4.271E-06	0.0	7.471E-06	7.471E-06
SUM	2.747E-04	2.771E-02	2.798E-02	2.276E-02	2.422E-02	4.696E-02	1.900E-02	2.379E-02	4.279E-02

TABLE 35 - $\frac{\text{PROPANE } D_1 - \text{PROPANE } D_0}{\text{PROPANE } D_0}$ Fe effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	1.849E-06	5.547E-04	5.566E-04	5.835E-07	1.444E-04	1.450E-04	6.184E-07	1.549E-04	1.555E-04
2	1.688E-07	2.256E-03	2.256E-03	5.361E-08	5.717E-04	5.718E-04	5.680E-08	6.146E-04	6.146E-04
3	3.261E-06	3.154E-02	3.155E-02	9.187E-07	6.777E-03	6.778E-03	9.793E-07	7.366E-03	7.367E-03
4	1.088E-05	1.862E-02	1.863E-02	2.826E-06	3.482E-03	3.485E-03	3.022E-06	3.808E-03	3.811E-03
5	6.002E-06	1.780E-02	1.781E-02	2.073E-06	3.922E-03	3.924E-03	2.190E-06	4.266E-03	4.268E-03
6	1.044E-05	5.221E-02	5.222E-02	4.386E-06	1.277E-02	1.277E-02	4.598E-06	1.383E-02	1.884E-02
7	2.177E-05	3.190E-02	3.192E-02	1.122E-05	8.225E-03	8.237E-03	1.172E-05	8.908E-03	8.920E-03
8	1.051E-06	2.286E-03	2.287E-03	2.772E-06	1.606E-03	1.609E-03	2.823E-06	1.692E-03	1.695E-03
9	0.0	0.0	0.0	1.231E-03	3.137E-02	3.260E-02	1.288E-03	3.414E-02	3.543E-02
10	0.0	0.0	0.0	1.326E-03	1.528E-03	2.855E-03	1.201E-03	1.469E-03	2.670E-03
11	0.0	0.0	0.0	3.338E-03	1.278E-03	4.616E-03	2.902E-03	1.189E-03	4.091E-03
12	0.0	0.0	0.0	8.793E-03	1.171E-03	9.965E-03	7.215E-03	9.667E-04	8.181E-03
13	0.0	0.0	0.0	1.588E-03	6.296E-04	2.217E-03	1.326E-03	6.340E-04	1.960E-03
14	0.0	0.0	0.0	2.232E-03	3.605E-04	2.593E-03	1.548E-03	2.508E-04	1.798E-03
15	0.0	0.0	0.0	6.714E-04	2.197E-05	6.933E-04	8.311E-04	-3.855E-05	7.925E-04
SUM	5.543E-05	1.572E-01	1.572E-01	1.920E-02	7.385E-02	9.305E-02	1.634E-02	7.925E-02	9.559E-02

TABLE 36 - $\frac{\text{PROPANE D1-PROPANE } D_0}{\text{PROPANE } D_0}$ Cr effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	2.214E-05	9.930E-05	1.219E-04	6.986E-06	2.622E-05	3.321E-05	7.403E-06	2.812E-05	3.552E-05
2	2.262E-05	4.060E-04	4.286E-04	7.182E-06	1.025E-04	1.097E-04	7.609E-06	1.103E-04	1.179E-04
3	1.317E-05	3.432E-03	3.445E-03	3.711E-06	7.450E-04	7.488E-04	3.956E-06	8.091E-04	8.131E-04
4	2.310E-05	3.039E-03	3.062E-03	6.000E-06	5.516E-04	5.576E-04	6.415E-06	6.043E-04	6.107E-04
5	1.043E-05	2.663E-03	2.673E-03	3.604E-06	5.967E-04	6.003E-04	3.808E-06	6.481E-04	6.519E-04
6	1.756E-05	2.807E-03	2.824E-03	7.374E-06	7.062E-04	7.136E-04	7.730E-06	7.632E-04	7.709E-04
7	2.814E-05	1.479E-02	1.482E-02	1.450E-05	3.790E-03	3.804E-03	1.514E-05	4.106E-03	4.121E-03
8	1.907E-06	4.140E-03	4.142E-03	5.032E-06	2.876E-03	2.881E-03	5.124E-06	3.030E-03	3.035E-03
9	0.0	0.0	0.0	6.228E-05	9.652E-02	9.659E-02	6.512E-05	1.055E-01	1.056E-01
10	0.0	0.0	0.0	3.359E-05	3.838E-03	3.871E-03	3.041E-05	3.710E-03	3.740E-03
11	0.0	0.0	0.0	4.854E-05	1.830E-02	1.835E-02	4.220E-05	1.722E-02	1.726E-02
12	0.0	0.0	0.0	2.479E-05	1.876E-03	1.901E-03	2.034E-05	1.543E-03	1.564E-03
13	0.0	0.0	0.0	4.912E-05	1.351E-03	1.400E-03	4.102E-05	1.361E-03	1.402E-03
14	0.0	0.0	0.0	2.708E-04	7.404E-04	1.011E-03	1.878E-04	5.102E-04	6.980E-04
15	0.0	0.0	0.0	7.498E-05	5.960E-05	1.346E-04	9.313E-05	-1.051E-04	-1.201E-05
SUM	1.391E-04	3.138E-02	3.152E-02	6.184E-04	1.321E-01	1.327E-01	5.372E-04	1.399E-01	1.404E-01

TABLE 37 - $\frac{\text{PROPANE D1} - \text{PROPANE } D_0}{\text{PROPANE } D_0}$ Ni effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	1.440E-05	2.041E-04	2.185E-04	4.543E-06	5.278E-05	5.732E-05	4.815E-06	5.664E-05	6.145E-05
2	1.317E-07	1.131E-03	1.131E-03	4.180E-08	2.892E-04	2.892E-04	4.429E-08	3.107E-04	3.107E-04
3	1.439E-07	3.569E-03	3.570E-03	4.052E-08	7.400E-04	7.401E-04	4.319E-08	8.054E-04	8.054E-04
4	2.295E-08	2.425E-02	2.425E-02	5.960E-09	4.056E-03	4.056E-03	6.372E-09	4.481E-03	4.481E-03
5	1.233E-07	2.350E-02	2.350E-02	4.231E-08	5.107E-03	5.107E-03	4.472E-08	5.569E-03	5.569E-03
6	6.875E-07	1.627E-02	1.627E-02	2.814E-07	3.882E-03	3.882E-03	2.955E-07	4.228E-03	4.228E-03
7	2.942E-06	3.031E-02	3.031E-02	1.500E-06	7.690E-03	7.692E-03	1.567E-06	8.369E-03	8.371E-03
8	2.952E-07	2.906E-03	2.907E-03	5.585E-07	1.476E-03	1.476E-03	5.770E-07	1.580E-03	1.581E-03
9	0.0	0.0	0.0	3.743E-05	3.868E-02	3.872E-02	4.387E-05	4.641E-02	4.645E-02
10	0.0	0.0	0.0	1.353E-05	7.781E-03	7.795E-03	1.491E-05	1.326E-02	1.328E-02
11	0.0	0.0	0.0	1.211E-06	9.051E-03	9.052E-03	1.585E-06	1.706E-02	1.706E-02
12	0.0	0.0	0.0	1.001E-04	6.400E-03	6.500E-03	1.438E-04	9.314E-03	9.458E-03
13	0.0	0.0	0.0	8.581E-05	1.715E-03	1.801E-03	2.954E-04	6.595E-02	6.625E-02
14	0.0	0.0	0.0	3.897E-04	1.095E-03	1.485E-03	5.226E-03	1.326E-01	1.379E-01
15	0.0	0.0	0.0	3.636E-04	-3.192E-05	3.317E-04	8.806E-03	1.452E-03	1.026E-02
SUM	1.875E-05	1.021E-01	1.022E-01	9.984E-04	8.799E-02	8.899E-02	1.454E-02	3.115E-01	3.260E-01

TABLE 38 - $\frac{\text{PROPANE D1-PROPANE } D_0}{\text{PROPANE } D_0}$ Na effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	6.134E-05	1.142E-03	1.204E-03	1.936E-05	2.968E-04	3.162E-04	2.051E-05	3.185E-04	3.390E-04
2	2.881E-05	5.444E-03	5.473E-03	9.147E-06	1.384E-03	1.393E-03	9.691E-06	1.488E-03	1.497E-03
3	2.121E-05	4.022E-02	4.024E-02	5.977E-06	8.602E-03	8.608E-03	6.372E-06	9.351E-03	9.358E-03
4	6.184E-05	5.098E-02	5.104E-02	1.606E-05	9.046E-03	9.062E-03	1.717E-05	9.939E-03	9.958E-03
5	4.834E-05	4.811E-02	4.816E-02	1.670E-05	1.054E-02	1.056E-02	1.764E-05	1.148E-02	1.150E-02
6	9.621E-05	7.828E-02	7.838E-02	4.040E-05	1.907E-02	1.911E-02	4.235E-05	2.068E-02	2.072E-02
7	1.567E-04	8.420E-02	8.435E-02	8.075E-05	2.161E-02	2.169E-02	8.432E-05	2.344E-02	2.353E-02
8	1.344E-05	1.002E-02	1.003E-02	3.523E-05	6.434E-03	6.469E-03	3.589E-05	6.803E-03	6.839E-03
9	0.0	0.0	0.0	1.688E-03	1.679E-01	1.696E-01	1.769E-03	1.875E-01	1.893E-01
10	0.0	0.0	0.0	1.556E-03	1.958E-02	2.114E-02	1.412E-03	2.469E-02	2.611E-02
11	0.0	0.0	0.0	3.452E-03	3.235E-02	3.580E-02	3.002E-03	3.891E-02	4.191E-02
12	0.0	0.0	0.0	9.715E-03	1.274E-02	2.246E-02	8.032E-03	1.452E-02	2.255E-02
13	0.0	0.0	0.0	2.214E-02	6.063E-03	2.820E-02	1.871E-02	7.035E-02	8.906E-02
14	0.0	0.0	0.0	3.695E-03	2.492E-03	6.187E-03	7.518E-03	1.336E-01	1.411E-01
15	0.0	0.0	0.0	1.110E-03	4.538E-05	1.155E-03	9.730E-03	1.316E-03	1.105E-02
SUM	4.879E-04	3.184E-01	3.189E-01	4.358E-02	3.181E-01	3.617E-01	5.041E-02	5.544E-01	6.048E-01

TABLE 39 - $\frac{\text{PROPANE D1-PROPANE } D_0}{\text{PROPANE } D_0}$ Total effects

GROUP	FAST FLUX 62 ABSORPT.	FAST FLUX 62 SCATTER.	FAST FLUX 62 TOTAL	TOTAL FLUX 62 ABSORPT.	TOTAL FLUX 62 SCATTER.	TOTAL FLUX 62 TOTAL	TOTAL FLUX 187 ABSORPT.	TOTAL FLUX 187 SCATTER.	TOTAL FLUX 187 TOTAL
1	-1.085E-05	1.470E-05	3.853E-06	-3.424E-06	3.804E-06	3.799E-07	-3.629E-06	4.084E-06	4.551E-07
2	-3.975E-05	-2.963E-06	-4.271E-05	-1.262E-05	-7.550E-07	-1.338E-05	-1.337E-05	-8.114E-07	-1.418E-05
3	-1.005E-04	-2.137E-03	-2.237E-03	-2.830E-05	-4.335E-04	-4.618E-04	-3.017E-05	-4.728E-04	-5.030E-04
4	-4.147E-03	-9.207E-03	-1.335E-02	-1.077E-03	-1.735E-03	-2.812E-03	-1.151E-03	-1.899E-03	-3.050E-03
5	-2.329E-03	-4.953E-04	-2.824E-03	-8.044E-04	-1.100E-04	-9.144E-04	-8.500E-04	-1.196E-04	-9.695E-04
6	7.860E-04	-4.477E-03	-3.691E-03	3.301E-04	-1.095E-03	-7.652E-04	3.460E-04	-1.187E-03	-8.406E-04
7	4.236E-03	-8.208E-03	-3.973E-03	2.183E-03	-2.172E-03	1.108E-05	2.279E-03	-2.349E-03	-6.909E-05
8	1.829E-04	1.485E-02	1.503E-02	4.825E-04	1.027E-02	1.076E-02	4.913E-04	1.083E-02	1.132E-02
9	0.0	0.0	0.0	7.789E-03	5.350E-02	6.129E-02	8.143E-03	5.821E-02	6.635E-02
10	0.0	0.0	0.0	1.524E-03	7.102E-04	2.235E-03	1.380E-03	6.902E-04	2.070E-03
11	0.0	0.0	0.0	-1.819E-03	-2.242E-03	-4.062E-03	-1.582E-03	-2.076E-03	-3.657E-03
12	0.0	0.0	0.0	5.410E-03	1.006E-03	6.416E-03	4.439E-03	8.222E-04	5.261E-03
13	0.0	0.0	0.0	2.800E-02	3.777E-03	3.178E-02	2.338E-02	3.829E-03	2.721E-02
14	0.0	0.0	0.0	6.563E-03	9.318E-04	7.495E-03	4.551E-03	6.447E-04	5.196E-03
15	0.0	0.0	0.0	-2.232E-04	-4.268E-05	-2.658E-04	-2.767E-04	7.466E-05	-2.021E-04
SUM	-1.423E-03	-9.662E-03	-1.108E-02	4.831E-02	6.237E-02	1.107E-01	4.110E-02	6.699E-02	1.081E-01

TABLE 40 - $\frac{\text{VIT.E-VIT.C}}{\text{VIT.C}}$ Fe effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-3.626E-04	1.670E-04	-1.955E-04	-1.144E-04	4.349E-05	-7.093E-05	-1.213E-04	4.665E-05	-7.461E-05
2	-2.206E-04	8.926E-05	-1.314E-04	-7.006E-05	2.262E-05	-4.743E-05	-7.422E-05	2.432E-05	-4.990E-05
3	-5.197E-05	-4.785E-04	-5.305E-04	-1.464E-05	-1.028E-04	-1.175E-04	-1.561E-05	-1.117E-04	-1.274E-04
4	-1.461E-02	-1.043E-04	-1.471E-02	-3.793E-03	-1.951E-05	-3.812E-03	-4.055E-03	-2.134E-05	-4.077E-03
5	-2.722E-03	3.600E-02	3.328E-02	-9.402E-04	7.932E-03	6.991E-03	-9.934E-04	8.628E-03	7.635E-03
6	8.224E-06	-5.730E-04	-5.647E-04	3.454E-06	-1.401E-04	-1.366E-04	3.621E-06	-1.518E-04	-1.482E-04
7	7.342E-06	3.964E-04	4.037E-04	3.784E-06	1.022E-04	1.060E-04	3.951E-06	1.107E-04	1.147E-04
8	1.083E-06	6.863E-05	6.972E-05	2.858E-06	4.822E-05	5.108E-05	2.911E-06	5.079E-05	5.370E-05
9	0.0	0.0	0.0	3.615E-04	2.220E-03	2.582E-03	3.780E-04	2.417E-03	2.795E-03
10	0.0	0.0	0.0	4.045E-05	-8.493E-04	-8.089E-04	3.662E-05	-8.162E-04	-7.796E-04
11	0.0	0.0	0.0	4.120E-06	3.943E-05	4.355E-05	3.582E-06	3.668E-05	4.026E-05
12	0.0	0.0	0.0	1.283E-03	9.000E-05	1.373E-03	1.052E-03	7.428E-05	1.127E-03
13	0.0	0.0	0.0	6.672E-05	3.101E-04	3.768E-04	5.572E-05	3.122E-04	3.679E-04
14	0.0	0.0	0.0	-9.507E-05	5.930E-05	-3.577E-05	-6.592E-05	4.126E-05	-2.466E-05
15	0.0	0.0	0.0	-2.046E-04	-9.816E-06	-2.144E-04	-2.533E-04	1.723E-05	-2.361E-04
SUM	-1.795E-02	3.557E-02	1.762E-02	-3.466E-03	9.746E-03	6.279E-03	-4.042E-03	1.066E-02	6.616E-03

TABLE 41. - $\frac{\text{VIT.E-VIT.C}}{\text{VIT.C}}$ Cr effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	5.006E-05	-1.588E-04	-1.087E-04	1.580E-05	-4.172E-05	-2.592E-05	1.674E-05	-4.474E-05	-2.799E-05
2	-7.400E-05	-7.800E-04	-8.540E-04	-2.350E-05	-1.970E-04	-2.205E-04	-2.490E-05	-2.119E-04	-2.368E-04
3	4.199E-04	-5.150E-03	-4.730E-03	1.183E-04	-1.118E-03	-9.998E-04	1.261E-04	-1.214E-03	-1.088E-03
4	4.015E-05	-1.643E-02	-1.639E-02	1.043E-05	-2.983E-03	-2.972E-03	1.115E-05	-3.267E-03	-3.256E-03
5	-5.095E-05	-9.086E-04	-9.595E-04	-1.760E-05	-2.036E-04	-2.212E-04	-1.859E-05	-2.211E-04	-2.397E-04
6	5.819E-06	2.199E-04	2.257E-04	2.444E-06	5.534E-05	5.778E-05	2.562E-06	5.981E-05	6.237E-05
7	9.852E-06	-6.020E-04	-5.921E-04	5.077E-06	-1.542E-04	-1.491E-04	5.302E-06	-1.671E-04	-1.618E-04
8	1.598E-06	3.713E-04	3.729E-04	4.217E-06	2.579E-04	2.621E-04	4.295E-06	2.717E-04	2.760E-04
9	0.0	0.0	0.0	1.836E-04	3.409E-03	3.593E-03	1.920E-04	3.727E-03	3.919E-03
10	0.0	0.0	0.0	4.582E-05	2.197E-04	2.655E-04	4.148E-05	2.124E-04	2.539E-04
11	0.0	0.0	0.0	5.847E-05	9.891E-04	1.048E-03	5.084E-05	9.305E-04	9.813E-04
12	0.0	0.0	0.0	1.478E-04	-4.272E-05	1.051E-04	1.212E-04	-3.515E-05	8.609E-05
13	0.0	0.0	0.0	-1.052E-06	3.004E-04	2.993E-04	-8.786E-07	3.024E-04	3.016E-04
14	0.0	0.0	0.0	1.060E-04	5.183E-05	1.578E-04	7.351E-05	3.572E-05	1.092E-04
15	0.0	0.0	0.0	-1.091E-04	-2.137E-05	-1.305E-04	-1.355E-04	3.769E-05	-9.784E-05
SUM	4.025E-04	-2.344E-02	-2.304E-02	5.467E-04	5.220E-04	1.069E-03	4.653E-04	4.157E-04	8.811E-04

TABLE 42 - $\frac{\text{VIT.E-VIT.C}}{\text{VIT.C}}$ Ni effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-1.097E-06	-7.684E-04	-7.695E-04	-3.456E-07	-1.987E-04	-1.990E-04	-3.664E-07	-2.132E-04	-2.136E-04
2	2.360E-08	-3.062E-03	-3.062E-03	7.497E-09	-7.829E-04	-7.829E-04	7.942E-09	-8.411E-04	-8.411E-04
3	1.184E-07	-8.150E-03	-8.150E-03	3.339E-08	-1.691E-03	-1.691E-03	3.559E-08	-1.840E-03	-1.840E-03
4	1.338E-06	-4.641E-02	-4.641E-02	3.422E-07	-7.781E-03	-7.781E-03	3.662E-07	-8.598E-03	-8.597E-03
5	5.584E-07	-3.566E-02	-3.566E-02	1.861E-07	-7.772E-03	-7.772E-03	1.969E-07	-8.479E-03	-8.479E-03
6	-4.139E-05	-1.601E-02	-1.605E-02	-1.573E-05	-3.852E-03	-3.868E-03	-1.661E-05	-4.206E-03	-4.222E-03
7	8.577E-05	-4.279E-02	-4.271E-02	3.225E-05	-1.091E-02	-1.087E-02	3.457E-05	-1.197E-02	-1.194E-02
8	7.011E-06	1.074E-02	1.075E-02	-1.778E-05	3.071E-03	3.054E-03	-1.674E-05	3.479E-03	3.463E-03
9	0.0	0.0	0.0	1.073E-03	-3.201E-03	-2.128E-03	1.285E-03	-4.539E-03	-3.255E-03
10	0.0	0.0	0.0	6.125E-04	-2.539E-03	-1.927E-03	8.163E-04	-8.511E-03	-7.695E-03
11	0.0	0.0	0.0	1.921E-04	-5.020E-03	-4.828E-03	2.950E-04	-1.279E-02	-1.249E-02
12	0.0	0.0	0.0	2.948E-03	6.588E-03	9.537E-03	4.135E-03	7.875E-03	1.201E-02
13	0.0	0.0	0.0	4.520E-03	7.547E-05	4.596E-03	1.933E-02	-1.674E-03	1.765E-02
14	0.0	0.0	0.0	1.015E-03	-4.437E-05	9.707E-04	9.062E-03	-3.391E-03	5.671E-03
15	0.0	0.0	0.0	-2.567E-03	7.367E-05	-2.493E-03	-6.275E-02	-3.740E-03	-6.649E-02
SUM	5.233E-05	-1.421E-01	-1.421E-01	7.794E-03	-3.398E-02	-2.618E-02	-2.783E-02	-5.944E-02	-8.727E-02

TABLE 43 - $\frac{\text{VIT.E-VIT.C}}{\text{VIT.C}}$ Na effects

GROUP	FAST FLUX 62			TOTAL FLUX 62			TOTAL FLUX 187		
	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL	ABSORPT.	SCATTER.	TOTAL
1	-3.245E-04	-7.454E-04	-1.070E-03	-1.024E-04	-1.931E-04	-2.955E-04	-1.085E-04	-2.072E-04	-3.157E-04
2	-3.344E-04	-3.756E-03	-4.090E-03	-1.062E-04	-9.580E-04	-1.064E-03	-1.125E-04	-1.029E-03	-1.142E-03
3	2.676E-04	-1.592E-02	-1.565E-02	7.541E-05	-3.345E-03	-3.270E-03	8.038E-05	-3.639E-03	-3.559E-03
4	-1.871E-02	-7.215E-02	-9.086E-02	-4.859E-03	-1.252E-02	-1.738E-02	-5.195E-03	-1.379E-02	-1.898E-02
5	-5.101E-03	-1.062E-03	-6.164E-03	-1.762E-03	-1.540E-04	-1.916E-03	-1.862E-03	-1.919E-04	-2.054E-03
6	7.586E-04	-2.084E-02	-2.008E-02	3.203E-04	-5.032E-03	-4.712E-03	3.356E-04	-5.484E-03	-5.149E-03
7	4.339E-03	-5.121E-02	-4.687E-02	2.224E-03	-1.313E-02	-1.091E-02	2.323E-03	-1.437E-02	-1.205E-02
8	1.925E-04	2.603E-02	2.623E-02	4.718E-04	1.365E-02	1.412E-02	4.818E-04	1.463E-02	1.511E-02
9	0.0	0.0	0.0	9.407E-03	5.593E-02	6.533E-02	9.998E-03	5.981E-02	6.981E-02
10	0.0	0.0	0.0	2.223E-03	-2.458E-03	-2.352E-04	2.274E-03	-8.425E-03	-6.150E-03
11	0.0	0.0	0.0	-1.565E-03	-6.234E-03	-7.798E-03	-1.232E-03	-1.390E-02	-1.513E-02
12	0.0	0.0	0.0	9.789E-03	7.641E-03	1.743E-02	9.747E-03	8.736E-03	1.848E-02
13	0.0	0.0	0.0	3.258E-02	4.463E-03	3.705E-02	4.276E-02	2.769E-03	4.553E-02
14	0.0	0.0	0.0	7.589E-03	9.986E-04	8.588E-03	1.362E-02	-2.670E-03	1.095E-02
15	0.0	0.0	0.0	-3.103E-03	-1.926E-07	-3.104E-03	-6.342E-02	-3.611E-03	-6.703E-02
SUM	-1.891E-02	-1.396E-01	-1.586E-01	5.319E-02	3.866E-02	9.185E-02	9.695E-03	1.863E-02	2.832E-02

TABLE 44 - $\frac{\text{VIT.E-VIT.C}}{\text{VIT.C}}$ Total effects

PART II

1 - Introduction

The following analysis of some of the major results of the LMFBR benchmark exercise was made using the fifteen-group cross section sets provided by the participants. These cross sections are explicitly given in some of the tables in Part I of the present document. For the sake of simplicity, some of the data already provided in Part I are duplicated in some tables of Part II.

The benchmark specifications, the responses requested and the fifteen energy group structure can be found in Annex I of the present document.

2 - GENERAL FEATURES OF THE NEUTRON DATA LIBRARIES

The benchmark solutions obtained up to now are largely based on ENDF/B data :

- VITAMIN - E (ORNL) on ENDF/B version 5
- VITAMIN - C (ORNL) ; JSD-100 file data (RADHEAT - Japan), EURLIB, BABEL & PROPANE-D_0 data (CEA/CNEN solutions) are based on ENDF/B version 4.

On the contrary, the PROPANE - D1 data are adjusted data based on neutron propagation experiments. Moreover, UKNDL data were used (UKAEA data).

Three main types of data processing methods have been used :

1 - $1/\Sigma_t$ type of weighting to process cross sections from the point data to multigroup data (VITAMIN - C and E, RADHEAT data /2,3,4/).

2 - Ultrafine flux weighting, mixture dependent, to take into account several self-shielding effects (BABEL data) /5/.

3 - Starting from data of method 2, a successive space dependent shielding procedure can be used to further reduce the number of energy groups. This procedure was applied to produce the PROPANE D_o formulaire data /6/.

The PROPANE D1 data are based on the PROPANE D_o formulaire, but are adjusted on neutron propagation experiments in sodium/steel mixtures, in the framework of the CEA/CNEN Cooperation /7,8/.

The UK data, supplied by McCracken and Miller, included also continuous Monte Carlo calculations, based on UKNDL data, using the Monte Carlo DUCKPOND code.

3 - MAIN RESULT DESCRIPTION

The main results are shown in tables 1 - 3.

3.1 TOTAL FLUX AND THE SODIUM CAPTURE RATE (Table 1)

Responses

The total flux and the sodium capture rate result dispersions are fairly large, in particular for the Na (n,γ) capture rate (sometime, more than a factor of two). In fact, one would expect a lower dispersion in view of the common origin of many data sets.

In fact, two groups of solutions seem to be present, namely the group of solutions based on the $1/\Sigma_t$ - type of processing, and the group based on ultrafine group flux weighting, which give consistently lower flux values.

In particular, lower flux values (∿ 30 ÷ 40 %) are observed in the lateral shield, and the discrepancy stays more or less constant in the sodium tank up to the heat exchanger (mesh 187). This seems to indicate that a possible role is played by the stainless-steel cross section processing. Pure sodium cross section are presumably less affected by the processing procedure ($1/\Sigma_t$ or ultrafine flux weighting for a pure sodium mixture, being very close).

In fact the additional discrepancy between BABEL and VITAMIN - C on $\emptyset_{tot}$ in the sodium tank (i.e. between mesh 62 and 187) is ∿ 15 %, i.e. of the some order of magnitude found between two $1/\Sigma_t$ - weighted data sets (RADHEAT and VITAMIN - C data at mesh interval 187). It is worth noting that the adjusted data tend to increase substantially the calculated unadjusted results.

3.2 HIGH ENERGY RESPONSES (TAB. 2)

The high energy responses (Φ > 100 KeV and the stainless-steel damage response, DPA) show also large dispersions. In particular, as it could have been expected, the high energy flux at deep penetration is strongly affected by both data and processing method differences. Differences on the DPA response is somewhat lower, due to the low energy neutron contribution at deep penetration.

Moreover it should be noted that some inconsistency can exist in the data presented, since both iron and steel DPA data are sometime quoted.

3.3 γ - HEATING AND n - HEATING DATA (TAB. 3)

The γ - heating data are fairly consistent, in particular if data up to mesh 62 are considered and which are shown in table 3. The neutron heating data are also consistent, except for the RADHEAT data at mesh 62.

In sumary both method and data influence the comparison among the different solutions. In section 4 some results of sensitivity analysis will be used to point out major data uncertainty effects and in section 6 some method related effects will be examined.

4 - SENSITIVITY ANALYSIS

Sensitivity coefficients were requested for both the original group structure (i.e. consistent with the multigroup data used) and for the reduced 15 energy group structure. A remarkable agreement is found in both the shape and the numerical values of the sensitivity profiles, which were calculated basically from two different code systems, the SWANLAKE /9/ system, and the SAMPO System /10/.

In Part I of the present paper, some sensitivity coefficients are provided in tables 4-3 for the different isotopes (Fe, Cr, Ni and Na, both in the lateral shield and in the Na tank). These are region integrated values relative to the fast flux at mesh 62 and to the total flux at meshes 62 and 187.

The folding of these sensitivity coefficients and of the 15 energy group cross section data supplied by the participants gives an indicative explanation of the discrepancies observed in tables 1 - 3. For example, some results of this exercise are shown in tables 20 and 24, where the VITAMIN - E/BABEL discrepancies are shown group-wise for the fast flux and the total flux.

The total effects (table 10) are fairly representative of the exact discrepancy data of table 1 and 2, even if some non-linear effects and group structure dependent effects are also present :

	DISCREPANCY BETWEEN VITAMIN - E AND BABEL	
	Based on direct calcul.	Based on sens 15 g calc.
Fast flux at mesh 62	107 %	48 %
Total flux at mesh 62	58 %	34 %
Total flux at mesh 187	73 %	42 %

The results for the total flux response of the tables show the predominant role played by the iron data (table 20) in particular the scattering data below ∿ 300 KeV and the capture data in the region below ∿ 2 KeV. Self-shielding effects could be at the origin of some of the observed discrepancies.

In the case of the fast flux response, the iron data indicate a strong effect of the scattering data below 1.35 MeV. Since Fe inelastic cross sections are different from zero only in the first four groups of the 15 energy group structure, these effects are mainly due to elastic scattering. Discrepancies of the order of 10 % in the scattering cross sections produce the observed fast flux response discrepancy.

5 - UNCERTAINTY ANALYSIS

To compare the observed discrepancies with the expected discrepancies on the basis of data uncertainty assessments, it was requested to the participants to fold the sensitivity coefficients with evaluated error matrices. The ORNL results indicate the following values, based on the existing ENDF/B - V uncertainty files, and on the ENDF/B - IV based 15 group covariances of Drischler and Weisbin /11/ :

Uncertainty on :	ENDF/B - V		ENDF/B - IV	
	Uncertainty Value	Correlation	Uncertainty Value	Correlation
Fe damage at mesh 20	4 %	25 %	3.4 %	31 %
Sodium Activation at mesh 187	65 %		69 %	

No other participant has supplied a consistent estimate of data uncertainty effects. However several hypothesis can be made on data uncertainties and indicative results can be obtained on the uncertainty of the different responses. For example the following data are obtained in the case of the total flux at mesh 187 :

UNCERTAINTY ON σ_a and σ_s	CORRELATION IN ENERGY	EFFECT ON TOTAL FLUX AT MESH 187
σ_a : 1 % σ_s : 10 %	1.0 0.5 0.	105 % 84 % 56 %
σ_a : 10 % σ_s : 10 %	1.0 0.5 0.	108 % 88 % 60 %
σ_a : 50 % σ_s : 10 %	1.0 0.5 0.	171 % 150 % 125 %
σ_a : 50 % σ_s : 20 %	1.0 0.5 0.	250 % 209 % 158 %

The results obtained show the predominant role played by σ_s uncertainties and that only very large uncertainties on σ_a can be relevant in the global uncertainty assessement. Finally, the impact of correlations is certainly very important, as it has been often stressed, even in the simplified calculations of the previous table.

6 - METHOD EFFECTS

The main solutions allowed also to analyse the impact of the method approximations on the benchmark calculated results. The proposed reference solution had a fixed mesh size grid (approximately 3 cm in steel/sodium mixtures and 4 cm in sodium), S_N order N = 4 and P_1 Legendre polynomial expansion order.

The participants provided data obtained in S_{16}, P_3 and with a doubled space mesh grid.

The results are summarized in tables 45 and 46. The following commentaries can be made :

- There is excellent agrements between VITAMIN - E and BABEL calculated effects. Similar effects, but somewhat different in absolute value, are shown by RADHEAT calculations.

- Method effects systematically give higher calculated values with respect to the simplified reference model (∿ 20 % for Φ_{tot} and Φ_{theq} on the HE).

- High energy flux is strongly affected, as it could be expected, by method effects.

- Separate effect analysis, show comparable order of magnitude of the different effects with a slight increase of S_N effects with propagation, except for P_n and, more pronounced, space mesh size in the case of the Φ > 100 KeV response (up to a factor of 4 global underestimation at mesh 187).

In conclusion, method approximations seems to be sufficiently understood. Major problems are certainly related to the correct modeling of 3D geometrical effects.

Finally, some processing effects have been investigated. In particular in table 47 we have indicated the effect on some typical response functions of the type of weighting used to generate multigroup cross section.

The influence of the fine weighting spectrum is large and the use of an appropriate method to handle self-shielding seems to be mandatory.

In this respect, the Monte Carlo results provided by UK and shown in table 48 seem to indicate that large discrepancies can be found if two widely different processing strategies are used. This indication applies to low energy responses, the high energy responses being in fairly good agreement. Therefore, if no normalization problem exists between the ANISN and DUCKPOND calculations, the results seem to indicate a larger self-shielding of resonances in the Monte Carlo calculations. Several participants at the meeting expressed their intention to perform more comparisons of that type.

Concerning the processing of scattering data, we have compared in the 15 group structure, the results obtained by two different, widely used codes to generate multigroup data, SUPERTOG and MC^2 - 2. Table 42 presents the results obtained for Fe. The inelastic scattering data compare fairly well, with the exception of the data close to the inelastic threshold. No major effect was found in the detailed inelastic matrix comparison.

In the case of elastic scattering, we have compared both the elastic $\sigma_{j \to j}$ and $\sigma_{j \to j+1}$ data for Fe. The infinite dilution data show the effect of the different algorithms of the two codes. The $\sigma_{j \to j}$ are in general good agreement with the exception of group 9 (273 - 67.4 KeV) where a discrepancy of $\sim$ 8 % is observed. Larger discrepancies are found in the elastic removal data, $\sigma_{j \to j+1}$, where, in the intermediate range, 10 ÷ 20 % differences are often found.

Even if it is difficult to draw general conclusions from the data presented, there is evidence of the well known difficulty of assessing the uncerainty associated to the data processing codes, both from the point of view of comparing different multigroup processing codes /12/, and from the point of view of comparing different data processing strategies /13/.

7 - CONCLUSIONS

At the present stage, more data should be compared and a more deep insight in many of the observed results is necessary. This will be the main objective of the coming specialist meeting.

However, the present picture indicates a somewhat improved situation in data dispersion, with respect to the previous Vienna 1976 meeting.

Since the data analysed so far are in general related to the ENDF/B files, the main discrepancies observed are due a) to data processing methods and b) to the effects of data adjustments on the basis of integral experiments. The method approximations seem to be well understood, even if they are difficult to extrapolate to more complex geometries.

The use of the sensitivity analysis, now a very well established technique, will help in identifing areas of uncertainties and needs for improvements.

Finally, the subject of target accuracies has not been explicitely touched in the benchmark exercise. It will be of interest to evaluate the possible impact of the discrepancies observed in the benchmark exercise on the assessement both of the present state of data uncertainties and on the design target accuracies.

It seems in fact that uncertainties other than data uncertainties should be taken into account in a global uncertainty assessement. In this perspective, the notion of design target accuracy could possibly evolve to take into account the need for defining appropriate bias factors on the major quantities of interest.

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	Φ total				Φ th eq			
	20	62	124	187	20	62	124	187
VITAMIN - E	1.008	1.103	1.149	1.214	1.009	1.100	1.137	1.189
RADHEAT	1.010	1.073	1.104	1.154	1.996	1.041	1.044	1.047
BABEL	1.0	1.122	1.148	1.209	1.0	1.089	1.140	1.202

	Φ > 100 KeV				DPA		$^{58}Co(n,\gamma)$	
	20	62	124	187	20	62	20	62
VITAMIN - E	1.012	1.212	1.711	3.81	1.010	1.152	1.007	1.098
RADHEAT	1.011	1.189	1.61	4.23	1.	1.083	1.	1.112
BABEL	1.008	1.204	1.741	3.87	1.010	1.140	1.	1.100

TABLE 45

GLOBAL METHOD APPROXIMATION EFFECTS

$(S_4\ P_1\ \Delta x \rightarrow S_{16}\ P_3\ (\Delta x/2))$

	Φ_{total}			$\Phi_{th\ eq}$		
	62	124	187	62	124	187
$P_1 \rightarrow P_3$	1.028	1.039	1.052	1.019	1.034	1.046
$S_4 \rightarrow S_{16}$	1.035	1.048	1.091	0.965	1.040	1.132
$\Delta x \rightarrow \Delta x/2$	1.036	1.054	1.058	1.117	1.057	1.003

	Φ > 100 KeV			DPA	Co (n,γ)
	62	124	187	62	62
$P_1 \rightarrow P_3$	1.098	1.27	1.41	1.06	1.025
$S_4 \rightarrow S_{16}$	1.099	1.087	1.05	1.082	1.021
$\Delta x \rightarrow \Delta x/2$	1.004	1.237	2.57	1.003	1.049

TABLE 46

SEPARATE METHOD APPROXIMATION EFFECTS

	Φ_{total}		$\Phi_{th\ eq}$		Φ> 820KeV	Φ> 14KeV
	62	187	62	187	62	62
Case 1	1.84	2.04	1.67	1.98	1.20	2.04
Case 2	1.17	1.22	1.15	1.22	1.07	1.25
Case 3	1.22	1.26	1.19	1.26	1.06	1.28

Reference case : Fe, Cr, Ni and Na weighted in a 50/50 SS/Na mixture spectrum

Case 1 : Fe weighted in a 100 % Fe spectrum. The other isotopes as reference

Case 2 : Fe weighted in a 100 % SS spectrum. The other isotopes as reference

Case 3 : Fe, Cr, Ni as in case 2. Na as in reference.

TABLE 47

Response	Method	MESH			
		20	62	124	187
ϕ>0.1MeV DPA	ANISN	4.03 + 11	1.92 + 7	2.28 + 1	2.15 - 5
	DUCKPOND	3.89 + 11	2.07 + 7	-	-
DPA	ANISN	1.37 + 14	1.29 + 10	1.67 + 7	2.74 + 4
	DUCKPOND	1.35 + 14	1.57 + 10	-	-
^{23}Na(n,γ)	ANISN	5.47 + 10	2.76 + 7	8.07 + 5	1.33 + 3
	DUCKPOND	-	-	2.59 + 6	3.87 + 3
^{59}Co(n,γ)	ANISN	2.43 + 13	8.62 + 9	7.21 + 7	9.55 + 4
	DUCKPOND	-	-	2.02 + 8	2.75 + 5
^{235}U(n,f)	ANISN	7.21 + 13	3.33 + 10	8.01 + 8	1.27 + 6
	DUCKPOND	-	-	2.70 + 9	4.06 + 6

TABLE 48

UK results using a) ANISN and $1/\Sigma_t$ weighting for iron (1/E for other isotopes) and b) continuous Monte Carlo (DUCKPOND code). The starting data file is the same (UKNDL) for the two calculations.

Group	SUPERTOG			MC^2 - 2		
	σ^j_{inel}	$\sigma_{el}(j\rightarrow j)$	$\sigma_{el}(j+1)$	σ^j_{inel}	$\sigma_{el}(j\rightarrow j)$	$\sigma_{el}(j+1)$
1	1.506	2.008	0.076	1.511	2.004	0.079
2	1.165	2.178	0.128	1.142	2.174	0.157
3	0.784	2.148	0.103	0.755	2.147	0.104
4	0.264	2.509	0.097	0.193	2.525	0.125
5		1.976	0.316		1.959	0.348
6		3.188	0.517		3.191	0.547
7		3.439	0.159		3.366	0.174
8		2.092	1.327		2.054	1.430
9		4.064	0.018		4.410	0.054
10		5.367	0.593		5.341	0.584
11		11.148	0.119		11.229	0.118
12		7.387	0.133		7.379	0.133
13		9.916	0.200		9.897	0.200
14		11.245	0.136		11.248	0.136
15	-	-	-	-	-	-

TABLE 49

FE INFINITE DILUTION DATA PROCESSED BY SUPERTOG AND MC^2 - 2

ANNEX I

DEFINITION OF A FAST BREEDER REACTOR BENCHMARK CONFIGURATION FOR COMPARISON OF SHIELDING CROSS-SECTION DATA

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- INTRODUCTION -

The benchmark characteristics are specified as follows :

- Section I-VII : benchmark specifications (in particular for the forward flux solution, required for all participants) ;
- Section VIII : uncertainty and sensitivity analysis specifications (optional).

I - GEOMETRY AND COMPOSITIONS -

They are directly obtained from the previous Benchmark definition /1/, as well as the space description (see Appendix I).

II - SOURCES -

The source spectrum is the same of reference /1/, but with the hypothesis of an isotropic angular distribution, to allow calculation at different angular quadrature orders.

The source spectrum is given in the 100 group structure. Both are given in Appendix II. The 100 group structure (DLC-2) is consistent with the following widely used libraries :

VITAMIN-E	(174 groups)
VITAMIN-C	(171 ")
EURLIB	(100 ")
BABEL	(113 ")
PROPANE	(45 ")

If a source redistribution in a fine structure should be necessary, we suggest the following :

$$S_i = S_I \frac{\Delta u_i}{\Delta u_I}$$

where I is the 100 groups structure index and i the finer group index.

III - TRANSPORT CALCULATION -

If the ANISN code is used, we suggest the following selected option values :

IBL = IBR = 0		(zero boundary conditions)
IFLU = 3		(weighted mode for difference equations)
XLAL = 10^{-3}	}	convergence tests
EPS = 10^{-4}		

The reference calculation should be S_4P_1 with the angular constants of Appendix III.

IV - CROSS SECTIONS -

It is suggested, in order to simplify the interlaboratory comparison, to use only one cross section set for each Benchmark region. This will not prevent however to use different "isotope" cross sections in each region (e.g. different Na cross sections in the PNL region, in the pure Na region and in the HE region).

V - PARAMETERS TO BE STUDIED -

The following space-dependent distributions should be considered :

- total flux
- thermal equivalent flux :

$$\phi_{theq}(r) = \int_0^\infty \sqrt{\frac{E_0}{E}}\ \phi(E,r)\ dE$$

with E_0 = .025 eV, E energy corresponding to the mean group lethargy.

- integral of the flux for energies > 100 KeV :

$$\phi(r)_{>100KeV} = \int_{E\ 100>KeV} \phi(E,r)\ dE$$

- (n,γ) capture rate of ^{23}Na
- (n,γ) capture rate of ^{59}Co
- damage in steel
- (n,f) fission rate of 235U
- γ and neutron heating on the lateral shield (w/cm^3 of homogeneized composition)

For all these parameters, selected point values should be provided according to the format of Appendix IV.

The calculation of the ^{23}Na and ^{59}Co capture rates and the ^{235}U fission rate, should be performed both with in-house response cross-section and with response cross-section derived from the generally available ENDF/B.V files. In the case of the atomic displacement, beside in-house cross-sections, a standard displacement model (e.g. the NRT model) could be used.

VI - METHOD TESTS -

A few simple method tests are also suggested in order to verify the influence of different cross section data on method approximations :

- a recalculation of the reference with both a doubled space mesh-grid and S_{16} (constants in Appendix III)
- a recalculation of the reference with P_3 option.

VII - TESTING OF DIFFERENT CROSS-SECTION SETS -

To simplify the result interpretation, it is asked that every laboratory participating to the exercice should provide (according to the format described in Appendix V) the folloxing data :

Microscopic cross sections by region :

1) Lateral shield : Na, Fe, Cr, Ni
2) Pure sodium : Na

in a 15 group structure (see Appendix VI).

This energy structure is the closest possible to the energy structure of the correlation matrices provided by ORNL.

The group collapsing should be performed starting from the reference calculation and using flux weighting algorithms (of the type used in ANISN).

VIII - SENSITIVITY AND UNCERTAINTY ANALYSIS -

As an option, beside the forward calculation described in Section I-VI, the participants are asked to perform sensitivity calculations for the following two responses :

- Atomic-displacement in Iron at mesh 20 ;
- Sodium activation-rate at mesh 187.

The plotted sensitivity profiles (per unit lethargy) are asked for the elastic and non-elastic cross-sections of Sodium, Iron, Chromium and Nickel.

The sensitivity can be calculated either in the 100-group structure or in the 15-group structure described in Section VII.

Sensitivity profiles could also be calculated for the other responses given in Appendix IV.

For what concerns the uncertainty analysis, the ORNL data (ORNL-5318 Report by JD.Drischler and CR. Weisbin) for Sodium and Iron could be used both directly in the 15 energy group structure, or expanded according to the procedure suggested in the paper "Preliminary version of the EURLIB variance-covariance matrices", by M. Hall (presented at the recent PARIS NEA Meeting), if the sensitivity analysis was performed in the original 100-group structure.

Fractional standard deviations should be provided for the two responses previously mentioned.

REFERENCE /1/ : JY. BARRE : "Benchmark specifications" see 1976 Vienna Specialist Meeting Proceedings.

- A P P E N D I X   I -

SPHERICAL GEOMETRY AND COMPOSITIONS

TABLE 1

ZONE	N°	Inner radius CM	Outer radius CM	Thickness CM	Composition
Source	1	236.5	236.51	0.01	(1)
Lateral shield	2	236.51	416.5	179.99	(1)
Sodium tank	3	416.5	916.5	500	(2)
HE	4	916.5	966.5	50	(3)
Sodium	5	966.5	1016.5	50	(2)

FIGURE 1

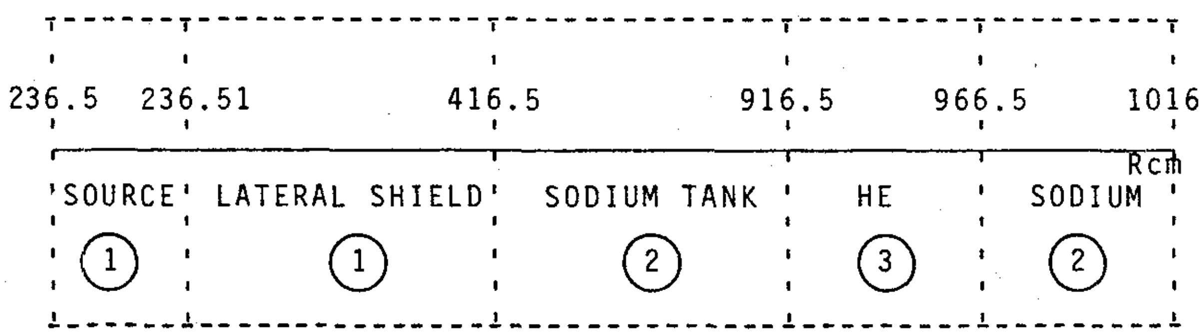

TABLE 2

ATOMIC COMPOSITION 10^{24} ATOMS/CM^3

REGION	Source and Lateral shield	Sodium tanks	HE
Composition label	(1)	(2)	(3)
% v/o SS*	53%	0%	15%
% v/o sodium	47%	100%	85%
Atoms/cm^3 x 10^{24}			
Sodium	.01045	.02223	.01890
Iron	.03200	.0	.00906
Nickel	.00423	.0	.00120
Chrome	.00860	.0	.00243

* Standard SS : ≃ 70 - 18 - 12 v/o Fe-Cr-Ni

TABLE 3

REFERENCE SPACE MESH GRID

ZONE	Zone number	Total mesh number	Mesh number	Number of meshes	Thickness CM	Radius CM
Source	1	1	1	1	0.01	236.5 236.51
Lateral shield	2	60	2 to 61	1 59	2.99 3.00	239.5 416.5
Sodium tank	3	125	62 to 186	125	4.00	916.5
HE	4	17	187 to 203	1 16	2.00 3.00	918.5 966.5
Sodium	5	13	204 to 216	1 12	2.00 4.00	968.5 1016

- APPENDIX II -

GROUP STRUCTURE AND SOURCE SPECTRUM

Group	Energy			Lethargy		
1	1.3499E 07	à	1.4918E 07	-0.400	à	-0.300
2	1.2214E 07		1.3499E 07	-0.300		-0.200
3	1.1052E 07		1.2214E 07	-0.200		-0.100
4	1.0000E 07		1.1052E 07	-0.100		0.000
5	9.0484E 06		1.0000E 07	0.000		0.100
6	8.1873E 06		9.0484E 07	0.100		0.200
7	7.4082E 06		8.1873E 06	0.200		0.300
8	6.7032E 06		7.4082E 06	0.300		0.400
9	6.0653E 06		6.7032E 06	0.400		0.500
10	5.4881E 06		6.0653E 06	0.500		0.600
11	4.9659E 06		5.4881E 06	0.600		0.700
12	4.4933E 06		4.9659E 06	0.700		0.800
13	4.0657E 06		4.4933E 06	0.800		0.900
14	3.6788E 06		4.0657E 06	0.900		1.000
15	3.3287E 06		3.6788E 06	1.000		1.100
16	3.0119E 06		3.3287E 06	1.100		1.200
17	2.7253E 06		3.0119E 06	1.200		1.300
18	2.4660E 06		2.7253E 06	1.300		1.400
19	2.2313E 06		2.4660E 06	1.400		1.500
20	2.0190E 06		2.2313E 06	1.500		1.600
21	1.8268E 06		2.0190E 06	1.600		1.700
22	1.6530E 06		1.8268E 06	1.700		1.800
23	1.4957E 06		1.6530E 06	1.800		1.900
24	1.3534E 06		1.4957E 06	1.900		2.000
25	1.2246E 06		1.3534E 06	2.000		2.100
26	1.1080E 06		1.2246E 06	2.100		2.200
27	1.0026E 06		1.1080E 06	2.200		2.300
28	9.0718E 05		1.0026E 06	2.300		2.400
29	8.2085E 05		9.0718E 05	2.400		2.500
30	7.4274E 05		8.2085E 05	2.500		2.600
31	6.7206E 05		7.4274E 05	2.600		2.700
32	6.0810E 05		6.7206E 05	2.700		2.800
33	5.5023E 05		6.0810E 05	2.800		2.900
34	4.9787E 05		5.5023E 05	2.900		3.000
35	4.5049E 05		4.9787E 05	3.000		3.100
36	4.0762E 05		4.5049E 05	3.100		3.200
37	3.6883E 05		4.0762E 05	3.200		3.300
38	3.3373E 05		3.6883E 05	3.300		3.400
39	3.0197E 05		3.3373E 05	3.400		3.500
40	2.7324E 05		3.0197E 05	3.500		3.600
41	2.4724E 05		2.7324E 05	3.600		3.700
42	2.2371E 05		2.4724E 05	3.700		3.800
43	2.0242E 05		2.2371E 05	3.800		3.900
44	1.8316E 05		2.0242E 05	3.900		4.000

Group	Energy		Lethargy	
45	1.6573E 05	1.8316E 05	4.000	4.100
46	1.4996E 05	1.6573E 05	4.100	4.200
47	1.3569E 05	1.4996E 05	4.200	4.300
48	1.2277E 05	1.3569E 05	4.300	4.400
49	1.1109E 05	1.2277E 05	4.400	4.500
50	8.6517E 04	1.1109E 05	4.500	4.750
51	6.7379E 04	8.6617E 04	4.750	5.000
52	5.2475E 04	6.7379E 04	5.000	5.250
53	4.0868E 04	5.2475E 04	5.250	5.500
54	3.1828E 04	4.0868E 04	5.500	5.750
55	2.4788E 04	3.1828E 04	5.750	6.000
56	1.9305E 04	2.4788E 04	6.000	6.250
57	1.5034E 04	1.9305E 04	6.250	6.500
58	1.1709E 04	1.5034E 04	6.500	6.750
59	9.1188E 03	1.1709E 04	6.750	7.000
60	7.1017E 03	9.1188E 03	7.000	7.250
61	5.5308E 03	7.1017E 03	7.250	7.500
62	4.3074E 03	5.5308E 03	7.500	7.750
63	3.3546E 03	4.3074E 03	7.750	8.000
64	2.6126E 03	3.3546E 03	8.000	8.250
65	2.0347E 03	2.6126E 03	8.250	8.500
66	1.5846E 03	2.0347E 03	8.500	8.750
67	1.2341E 03	1.5846E 03	8.750	9.000
68	9.6112E 03	1.2341E 03	9.000	9.250
69	7.4852E 02	9.6112E 02	9.250	9.500
70	5.8295E 02	7.4852E 02	9.500	9.750
71	4.5400E 02	5.8295E 02	9.750	10.000
72	3.5357E 02	4.5400E 02	10.000	10.250
73	2.7536E 02	3.5357E 02	10.250	10.500
74	2.1445E 02	2.7536E 02	10.500	10.750
75	1.6702E 02	2.1445E 02	10.750	11.000
76	1.3007E 02	1.6702E 02	11.000	11.250
77	1.0130E 02	1.3007E 02	11.250	11.500
78	7.8893E 01	1.0130E 02	11.500	11.750
79	6.1442R 01	7.8893E 01	11.750	12.000
80	4.7851E 01	6.1442E 01	12.000	12.250
81	3.7267E 01	4.7851E 01	12.250	12.500
82	2.9023E 01	3.7267E 01	12.500	12.750
83	2.2603E 01	2.9023E 01	12.750	13.000
84	1.7603E 01	2.2603E 01	13.000	13.250
85	1.3710E 01	1.7603E 01	13.250	13.500
86	1.0677E 01	1.3710E 01	13.500	13.750
87	8.3153E 00	1.0677E 01	13.750	14.000
88	6.4760E 00	8.3153E 00	14.000	14.250

Group	Energy		Lethargy	
89	5.0435E 00	6.4760E 00	14.250	14.500
90	3.9279E 00	5.0435E 00	14.500	14.750
91	3.0590E 00	3.9279E 00	14.750	15.000
92	2.3824E 00	3.0590E 00	15.000	15.250
93	1.8554E 00	2.3824E 00	15.250	15.500
94	1.4450E 00	1.8554E 00	15.500	15.750
95	1.1254E 00	1.4450E 00	15.750	16.000
96	8.7642E-01	1.1254E 00	16.000	16.250
97	6.8256E-01	8.7642E-01	16.250	16.500
98	5.3158E-01	6.8256E-01	16.500	16.750
99	4.1399E-01	5.3158E-01	16.750	17.000
100	E < 4.1399 ev 10^{-1}		u > 17.00	

ISOTROPIC SOURCE SPECTRUM

COMPONENTS 4 AND 5 OF ANGULAR GRID

Group N°	Ø 4 = ϕ_5
1	6.02524E07
2	1.81727E08
3	4.07211E08
4	9.42370E08
5	1.95173E09
6	3.52236E09
7	6.27127E09
8	9.84427E09
9	1.58784E10
10	2.08818E10
11	3.05881E10
12	3.57854E10
13	4.37794E10
14	4.27307E10
15	5.09825E10
16	7.42581E10
17	9.74418E10
18	1.08859E11
19	1.31778E11
20	1.12294E11
21	1.06088E11
22	1.19919E11
23	1.22713E11
24	1.43676E11
25	1.38604E11
26	1.68639E11
27	1.21492E11
28	1.37396E11
29	2.31932E11
30	3.17939E11
31	3.58870E11
32	4.61146E11
33	5.45901E11
34	6.05226E11
35	4.10883E11
36	3.35203E11
37	4.14334E11
38	6.16085E11
39	6.74255E11
40	7.75847E11
41	7.73701E11
42	8.05348E11
43	7.97731E11
44	9.60821E11
45	8.96930E11
46	9.01712E11
47	1.07587E12
48	1.07842E12
49	1.09122E12
50	2.90643E12

Group N°	Ø 4 = ϕ_5
51	3.27689E12
52	2.34726E12
53	3.46194E12
54	3.26389E12
55	3.84814E12
56	3.92430E12
57	2.52851E12
58	2.76140E12
59	2.69055E12
60	1.87633E12
61	1.86242E12
62	1.60780E12
63	9.22607E11
64	2.26337E11
65	1.15389E12
66	1.57888E12
67	1.43406E12
68	1.17007E12
69	9.04616E11
70	7.21524E11
71	5.61813E11
72	3.85968E11
73	2.63066E11
74	2.07377E11
75	1.50525E11
76	1.43630E11
77	3.99921E10
78	8.70758E10
79	2.03617E10
80	5.84330E10
81	6.25251E10
82	8.45539E09
83	3.26659E10
84	1.89189E09
85	2/17767E10
86	3.09199E10
87	3.41943E10
88	5.53856E08
89	4.99411E09
90	1.45122E10
91	1.68612E10
92	1.70436E10
93	1.59551E10
94	1.42725E10
95	1.20954E10
96	9.80882E09
97	7.67665E09
98	5.62878E09
99	3.58773E09
100	2.17189E09

- A P P E N D I X III -

ANGULAR DATA FOR S_N CALCULATIONS

S_4 Calculations :

ANGULAR QUADRATURE CONSTANTS		
COSINE (MU)	WEIGHT	REFL DIRECTION
- 1.00000E+00	0	5
- 8.61130E-01	1.73400E-01	5
- 3.39980E-01	3.26570E-01	4
3.39980E-01	3.26570E-01	3
8.61130E-01	1.73400E-01	2

S_{16} Calculations :

ANGULAR QUADRATURE CONSTANTS		
COSINE (MU)	WEIGHT	RELF DIRECTION
- 1.00000E+00	0	17
- 9.89400E-01	1.35760E-02	17
- 9.44574E-01	3.11270E-02	16
- 8.65630E-01	4.75790E-02	15
- 7.55404E-01	6.23140E-02	14
- 6.17876E-01	7.47979E-02	13
- 4.58017E-01	8.45779E-02	12
- 2.81604E-01	9.13010E-02	11
- 9.50129E-02	9.47250E-02	10
9.50129E-02	9.47250E-02	9
2.81604E-01	9.13010E-02	8
4.58017E-01	8.45779E-02	7
6.17876E-01	7.47979E-02	6
7.55404E-01	6.23140E-02	5
8.65630E-01	4.75790E-02	4
9.44574E-01	3.11270E-02	3
9.89400E-01	1.35760E-02	2

- A P P E N D I X IV -

	Lateral shield interval		Sodium tank interval	
	20	62	124	187
ϕ_{total}				
$\phi_{th\ eq}$				
ϕ>100 KeV				
$^{23}Na(n,\gamma)$				
$^{59}Co(n,\gamma)$				
$^{235}U(n,f)$				
DPA				
γ-heating (w/cm^3)				
neutron heating (w/cm3)				
Total heating (w/cm3)				

- A P P E N D I X V -

Data format (Data to be sent as punched cards) should be the standard ANISN format, with :

IHM = 20
IHT = 5
IHS = 6

Position 1 and 2 can be used for $\sigma(n,\gamma)$ (Position 2) and for total inelastic, if available (Position 1).

- A P P E N D I X VI -

15 ENERGY GROUP STRUCTURE FOR SENSITIVITY CALCULATIONS

Group	E_{lower} for group
1	4.49 MeV
2	2.59
3	1.35
4	.706
5	.578
6	.407
7	.302
8	.273
9	67.4 KeV
10	31.8
11	15.0
12	1.58
13	214 eV
14	10.7
15	down to thermal

Specialists' Meeting on Shielding Benchmark Calculations

1st and 2nd July, 1982, OECD, Paris

LIST OF PARTICIPANTS AND CONTRIBUTORS

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